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DIAGNOSIS & TREATMENT
OF
TUMORS
OF THE
HEAD AND NECK

(Not including the Central Nervous System)

By

GRANT E WARD M D D Sc F A C S

and

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In memory of our parents

FLETCHER D AND HARRIETT W WARD

and

HUMPHREY G AND MARGARET F HENDRICK

FOREWORD

I have been familiar with Dr Ward's work and intensely interested in it since 1930, when he and Dr J Mason Hundley, Jr organized and took over the supervision and much of the work of a cancer clinic in the University Hospital as one of the sections of the department of surgery Dr Hundley was interested in the gynecological problems and Dr Ward in those of surgery His especial knowledge and training had to do with neoplasms of the face neck and scalp, the mouth the skin and the breast, and he had an unusual opportunity to study them.

He graduated at the Johns Hopkins Medical School in 1921 and from 1922 to 1927 he was an associate at the Howard A Kelly Hospital where, among other things, he became versed in the use of radium and the X ray in cancer treatment and in the value of electrosurgery as an operative procedure In 1925 Dr Kelly began to get together his material for a book on electrosurgery and asked Dr Ward to be co-author Dr Ward in fact did most of the writing of this work. In addition, he has written and published between fifty and sixty papers, most of them dealing with malignancies

At University Hospital his work has been almost entirely confined to the field of cancer and he is a skilful, cautious and tireless operator In spite of the discouraging field in which he works, he is cheerful hopeful, and courageous. Much of his success has been due to faithful watchfulness of his patients over long periods of time

I first knew Dr Hendrick as an American soldier in World War I, when he was wounded and brought in to Evacuation Hospital 8, during the Argonne offensive.

He graduated from the University of Indiana in 1926. Following internship and residency in the United States he obtained a fellowship in surgery for eighteen months in von Eiselsberg's Clinic at the University of Vienna Returning to America, he went to Texas and occupied himself with the practice of surgery with special attention to surgical problems of the neck.

Dr Hendrick came to the University Hospital in 1945 Here he spent several years in the Tumor Clinic as an associate of Dr Ward. He has now returned to San Antonio Texas, to resume the practice of surgery with an especial interest in the problems of cancer

ARTHUR M SHIPLEY

FOREWORD

It affords me pleasure to comply with the request of my good friend, Grant E Ward, to write a few introductory remarks to this book which he has written in collaboration with James W Hendrick. It has been my good fortune to know Grant Ward since our time together in medical school and I have followed his career with much interest He worked very closely with Dr Howard A. Kelly for a number of years beginning in 1922 and his particular interest at the time was in the development of electrosurgical technic. He and Dr Kelly published a book on this subject in 1932 Electrosurgery is of great aid in the management of many difficult problems encountered in the treatment of tumors of the head and neck and considerable attention is given to this method in this book. Because of his vast experience in surgery and in the use of radium and x ray Dr Ward is well qualified in selecting the treatment according to the indications presented by the patient and without preconceived ideas which may result if one has been trained in only one method of therapy

In 1930 Dr Ward and Dr J Mason Hundley Jr established a tumor clinic at the University of Maryland Hospital and in 1939 Dr Ward established a similar clinic at the Johns Hopkins Hospital Work in these two clinics plus that in a large private practice has resulted in a very wide experience in the treatment of tumors of the head and neck. Fortunately for all concerned he has given unselfishly of his time and effort in instructing the students and house officers.

James W Hendrick received his training at the Indianapolis City Hospital the University of Maryland Hospital and Von Eiselsberg's clinic in Vienna after graduation from the University of Indiana. Following an extended period of surgical practice in Texas, a large part of which was devoted to surgery of the neck, he returned to Baltimore and has been associated with Dr Ward in much of his work during the past several years.

Doctors Ward and Hendrick have wisely called upon some of their friends and associates at the University of Maryland Hospital and the Johns Hopkins Hospital for aid in writing of such chapters as those on tumors of the larynx and tumors of the eyes and orbit in which the experience of the general surgeon is limited These and similar chapters add to the value of the book.

With the enormous development of surgery during the present century the increasing need for books which deal extensively with disorders of a limited part of the body has become apparent. This book should be helpful to the general surgeon plastic surgeon dental surgeon and x ray therapist as well as to all who are interested in diagnosis and treatment of tumors of the head and neck.

ALFRED BLALOCK

PREFACE

The purpose of this book is to furnish the reader practical information regarding the diagnosis and treatment of tumors of the head and neck. It is written for the clinician be he specialist or general practitioner The importance of early diagnosis is stressed and the proper choice of treatment is emphasized. Each year a considerable number of patients come to the clinics in advanced stages of cancer who could have been cured had the clinician first consulted recognized the disease and insisted on proper treatment The value of biopsy as a diagnostic study and guide to therapy is mentioned repeatedly

A chapter on embryological considerations of the head and neck is included to assist in understanding the types of tumors encountered in these areas A discussion of pathology accompanies each section to aid in diagnosis and to lay the foundation for treatment. Sir William Osler has aptly said, "As is our pathology, so is our practice ' Since the management of patients with tumors in the regions covered in this volume frequently requires knowledge and experience in several fields of medicine, some of the chapters and sections are contributed by specialists to make the presentation of material authentic

Far too often the surgeon or radiologist views the patient and his malady in the light of his own training and experience without adequate information of the value of the other's therapy and without recognizing the limitations of his own field. We have compared both methods of treatment and suggested our choice based on years of experience in surgery and radiation therapy

The clinical and pathological material for this work has been made available by the School of Medicine of the University of Maryland and the University Hospital, the Johns Hopkins University School of Medicine and the Johns Hopkins Hospital, and the Baltimore College of Dental Surgery Dental School, University of Maryland. In recent years, tumor clinics in these hospitals have concentrated patients for study and treatment To this wealth of material has been added that from our private practices.

Many colleagues and associates have given generously of their time and effort in accumulating and preparing the material for publication and in writing parts of the manuscript To all of these we express gratitude and appreciation. Special acknowledgement is due the following

Our efficient and loyal secretary, Mrs. Ethel Caskey who for the past year has labored long and hard in preparing the manuscript. Her fine sense of humor has lightened the load

Miss Nancy Ferneyhough, our chief medical artist for carefully depicting operative procedures and anatomical structures

Mrs Garland White a most careful and thorough office secretary, who for twenty years has kept accurate case records so essential in studying malignant disease.

The Departments of Art as Applied to Medicine under the directors Mrs Ranice Birch Davis (Johns Hopkins University School of Medicine) and Dr Carl Dame Clarke (School of Medicine, University of Maryland) have contributed a wealth of illustrations Other members of these departments who are

intensely interested in this project and have worked incessantly are Mrs. Elizabeth Blumenthal Mr Luther Gilliam, Mrs. Edna Jackson, and Mrs. Ray Brickner (Johns Hopkins) and Miss Frances Blackburn, Mr Richard Gill and Mr Thomas A. Burns (University of Maryland)

Dr Hugh R Spencer Professor of Pathology School of Medicine, University of Maryland lent valuable assistance in assembling pathological material

Dr Myron S Aisenberg Professor of Pathology Baltimore College of Dental Surgery Dental School University of Maryland, for reviewing the chapter on Tumors of the Jaws and for making helpful suggestions.

Dr Morgan Berthrong of the Department of Pathology, Johns Hopkins University School of Medicine gave helpful advice in the preparation of the pathological material for the chapter on salivary tissue tumors and the section on carcinoma of the thyroid gland

Mrs R Corbin Taylor Mrs. Dorothy H Duvall and Miss Ruth M Murray, secretaries of the tumor clinics accumulated follow up data on several series of cases

Doctors Robert G Chambers and Marvin M Lacy, Trainees in Cancer Diagnosis and Therapy of the National Cancer Institute assigned to the School of Medicine University of Maryland were indispensable in studying several series of cases and reviewing literature

Doctors Arthur G Siwinski, Edwin H Stewart, and Harold P Biehl (Trainee, National Cancer Institute assigned to the School of Medicine University of Maryland) made helpful clinical studies

The publishers Williams and Wilkins Company have cooperated in every respect in bringing this work to completion The president and his staff have offered many helpful suggestions and have allowed the free use of illustrations and color plates.

GRANT E WARD
JAMES W HENDRICK

1950

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Chapter I

INTRODUCTION

GENERAL CONSIDERATIONS

The head and neck constitute a small portion of the volume of the human body, having packed within a limited space a large number of structures of varied embryological origin and of diverse histological characteristics, all covered by skin. Organs developed from ectodermal anlages skin, mouth teeth, salivary and nerve tissue are closely associated with mesodermal derivations, as connective tissue, bone, muscle, and blood vessels Endoderm, too contributes its share in the formation of the pharynx and esophagus. From this great collection of anatomical parts a large gamut of neoplasms may arise from small benign tumors to rapidly growing and metastasizing cancers

Because of the numerous and varied structures confined within a small area a tumor, benign or malignant arising in any one organ soon presses upon or invades those adjacent, making the problems of diagnosis and therapy complex and complicated. No one clinician masters all of these problems. Dermatologist, oral surgeon, dentist, otolaryngologist, ophthalmologist, radiologist, general surgeon, plastic surgeon, and at times the neurosurgeon, focus their attentions on this field of medicine Often two or more of these specialists work in close cooperation in the diagnosis and treatment of tumors of the head and neck. The internist and general practitioner repeatedly are confronted with patients requiring diagnosis of a benign tumor or premalignant or malignant lesion They must know the importance of early recognition and prompt therapy

Cancer of the head and neck is predominantly an accessible disease and in the majority of patients should be diagnosed early It is an axiom in cancer therapy that the earlier the diagnosis the better the clinical result. Therefore, the death rate from cancer of the head and neck should be lower in proportion to the incidence than from cancer in inaccessible regions, such as the lungs, gastrointestinal tract, liver, etc.

There were 199,267 cancer deaths in the United States in 1947 (Dorn) Cancer of the head and neck causes about 14 per cent of all cancer deaths (exclusive of deaths from brain tumors and malignant lymphomas beginning in the head and neck region) Eleanor J Mac Donald (1948) reported from the Cancer Record Registry, Division of Cancer and Other Chronic Disease Connecticut State Department of Health the percentage of cancer deaths according to sites Adding the percentages from the various sites in the head and neck, including skin, but excluding brain and malignant lymphomas arising in this region, it is found that 14 7 per cent of cancer deaths are from cancer of the head and neck.

In like manner, by adding the similar figures in Table II—"Statistics on Cancer" a booklet published by The American Cancer Society (1949) it is found that 14 2 per cent of cancer deaths are due to cancer of the head and neck.

Early diagnosis and prompt and adequate treatment by radiation or surgery alone or combined should reduce this mortality rate.

In this introductory chapter, the value of careful histories and an outline of the types of examination to be made will be given, followed by discussions of the fundamentals of surgery and radiological therapy in preparation for a specific consideration of diagnosis and treatment in the subsequent chapters.

This treatise will not include tumors of the central nervous system

HISTORY

A carefully taken and accurately evaluated history is the essential beginning in making a diagnosis of a suspected tumor of the head and

neck. Diseases of short duration are apt to be inflammations those present for several weeks or months are more likely to be neoplasms, benign or malignant, and those present for years or since birth, of congenital origin. *Habits*, modes of living (exposure to the elements) injuries, both acute and chronic, and recent infections must be taken into consideration

EXAMINATION

Inspection and palpation are as important in examining the head and neck as in examining other parts of the body Many times information can be obtained by palpation which is impossible by inspection alone. Ulcers and tumors vary in consistency from normal tissue. During palpation, the examiner must bear in *mind the possible histopathological, as well as* gross, changes occurring in the disease processes under suspicion

Inflammations usually begin with localized erythema which, when visible on the surface of the skin or in the oral cavity gives a red appearance with increased local temperature. There is edema due to perivascular infiltration of fluid and leukocytes, followed in the more chronic cases by lymphocytes. The more chronic the inflammation, the more infiltrated is the area with lymphocytes and fibroblasts coming in to repair At the same time the early *soft edematous tissue becomes firmer* but rarely attains the stony hardness of malignancy

Malignant disease gives rise to two types of tissue change (1) the rapid growth of the tumor itself and (2) the reaction of the host in its defense mechanism around the tumor Malignant tumor cells grow rapidly and, when vegetating externally, will not be compact and *hard* but when infiltrating into surrounding tissues their expansion is limited consequently the tumor cells are packed closely together The host builds at first a protective wall of leukocytes and, later lymphocytes, scar tissue, and fibroblasts. The combination of rapidly growing cells closely packed together and the surrounding wall of fibrous tissue produces a very hard tumor mass. A malignant tumor is stony hard and when attached to bone is often difficult to differentiate, by palpation, from bone

Benign tumors, on the other hand, have a rubbery consistency, intermediate between the brawny induration of chronic inflammation and the stony-hardness of cancer They are usually well delineated by their capsule and grow slowly *giving time for expansion of the capsule* and for the surrounding soft tissues and at times, bone to accommodate to the neoplasm The tumor cells are not so compact, as a rule, as in cancer Slow growth and encapsulation do not stimulate the host to produce a lymphocytic and fibrotic wall therefore, benign tumors are usually freely movable whereas malignant ones invade and fix themselves to the *surrounding tissues.*

GENERAL INSPECTION

The general symmetry and contour of the head and neck are noted. No person is perfectly symmetrical the ears vary the eyelids and orbits are not exactly the same on both sides the nose may be slightly crooked the mouth may be longer from midline to one corner than from midline to the other There may be normal variations in the neck to be differentiated from any asymmetry due to tumor or other disease

Skin. *The color and texture of the skin are* important Certain diseases, notably hyperkeratosis occur in people who have been exposed to the elements Their skin is usually dry and of higher color than the average person's. Swellings, ulcerations and other changes in color are searched for

Eyes. Tumors, ulcerations ectropion, entropion, exophthalmus, enophthalmus fixation of the eyeballs, and other abnormalities are to be noted.

Nose. Tumors of the skin of the nose are frequent. They may begin as tiny lumps or ulcerations which are detected on inspection. The nostrils are carefully examined with a bivalve speculum and a head mirror It is essential for anyone examining the head and neck to be familiar with the use of the head

mirror for reflected light or some form of head light, to illuminate the cavities of the head for inspection and instrumentation when necessary

Mouth. A routine medical examination of the mouth is far too often hasty The average examination consists of asking the patient to *open the mouth and say 'ah'* About all that is accomplished thus is a cursory glance at the surface of the tongue, occasionally the inside of the cheeks and the palate, and perhaps a slight glimpse of the tonsils. Many tumors are not recognized by such superficial inspection. On examining the mouth, the lips are inspected

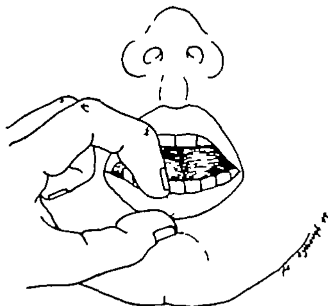


Fig. 1 Technic of palpation of the lip between finger and thumb.

first and, if an abnormality is found, palpated between the thumb and index finger, preferably covered by a glove or finger cot (Fig 1) The lips are lifted away from the gingiva and the cheeks pulled aside with a spatula for adequate inspection of the entire buccal mucous membrane and upper and lower buccogingival and labiogingival sulci (Fig 2) The patient is asked to put out his tongue for careful observation of each side (Figs. 3 and 4), and is requested to raise the tip of the tongue to the roof of the mouth for an adequate view of the under surface and the floor of the mouth (Fig 5) When the patient withdraws the tongue the examiner pushes it to the midline with a spatula for inspection of the labial side of each gingiva and for the floor of the mouth between the tongue and the jaw (Fig 6)

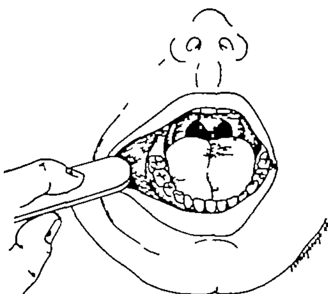


Fig 2. Cheek is retracted for inspection of the buccal mucosa

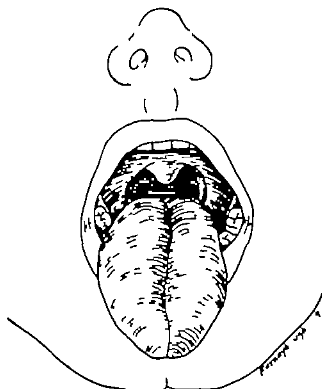


Fig 3 Inspection of the dorsum of the tongue

The hard and soft palate uvula, tonsillar fossae, and oropharynx are carefully examined. A small retractor pulls aside the anterior pillars of the fauces for adequate inspection of the tonsils or tonsillar fossae.

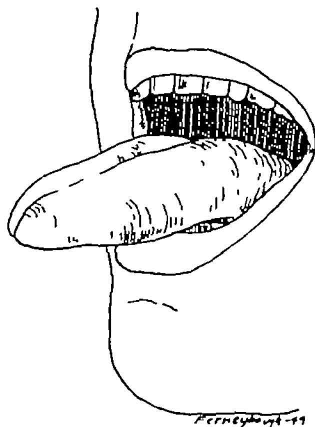


Fig. 4. Inspection of the lateral border of the tongue

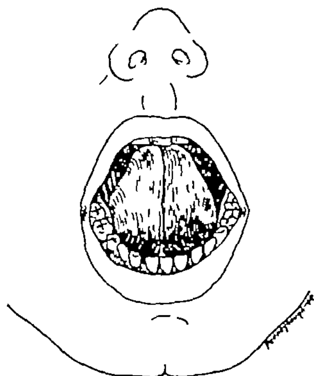


Fig 5 Inspection of the undersurface of the tongue. The tip of the tongue is lifted by the patient towards the roof of the mouth.

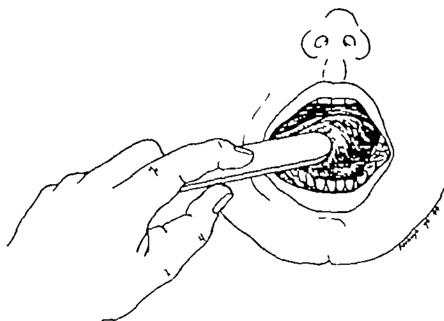


Fig. 6. Inspection of floor of the mouth and lingual side of the jaw and buccal side of the tongue far back The tongue is pulled medially with a spatula.

The use of a throat mirror is important. With a head light or reflected light of a head mirror illuminating the throat mirror inspection is made of the lingual sides of the upper and lower anterior teeth (Fig 7) Often small lesions, of which the patient may or may not complain, are discovered in this way The throat mirror is then used to inspect the naso-

pharynx and back of soft palate and posterior nares (Fig 8) In like manner when the tongue is pulled out, the vallecula and epiglottis and vocal chords are examined (Fig 9)

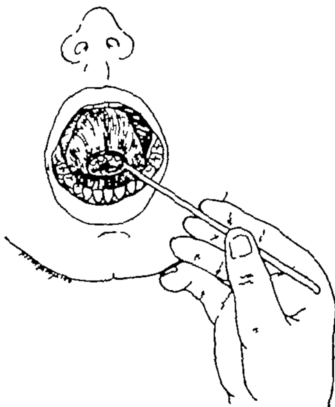


Fig 7 Inspection of the lingual side of the symphyseal region of the lower jaw and incisor teeth with throat mirror Similarly the throat mirror is used to inspect the lingual side of the symphyseal region of the upper jaw and incisor teeth

PALPATION OF THE MOUTH AND PHARYNX

Ulcers and tumors in the oral cavity or pharynx are carefully palpated with a gloved finger (Fig 10) Most acute ulcers are soft Chronic ulcers may be firm Any indurated area in an ulcer requires biopsy A chronic ulcer is considered malignant until proved otherwise. Frequently, much information about the submucous extension of the tumor not recognizable on inspection alone, is obtained by palpation. Tumors at the base of the tongue or in the vallecula or along the pharyngeal walls or tonsillar areas are more accurately outlined by the examining finger than by inspection alone. Occasionally an invisible tumor may be discovered by palpation. Every now and then a patient will complain of severe pain in the tongue without visible

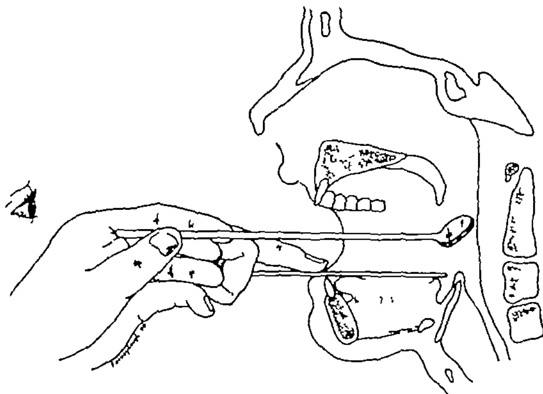


Fig 8. Inspection of nasopharynx with throat mirror The clinician usually wears a head mirror or headlight for lighting the throat mirror

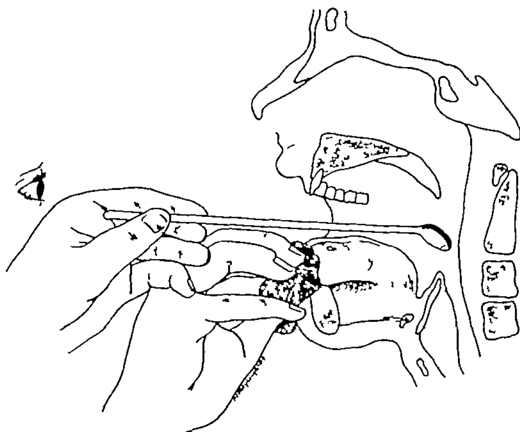


Fig 9 Inspection of the hypopharynx, epiglottis, vallecula, base of the tongue and larynx with throat mirror

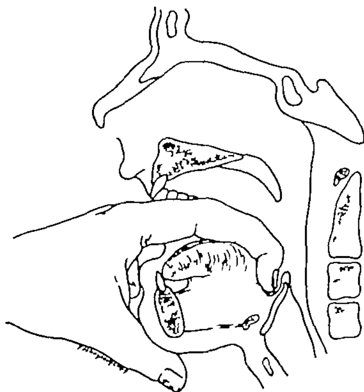
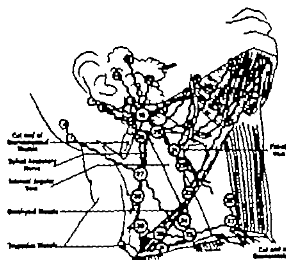


Fig 10. Palpation of base of the tongue and hypopharynx with finger This is an exceedingly important maneuver determine the consistency of tumors and to pick up hidden tumors that lie beneath the mucosa and may not seen with the mirror or with direct laryngoscopy



A

Retropharyngeal glands

Afferent vessels of retropharyngeal glands

Afferent vessel to deep cervical glands

Glandular nodule

Gland of deep cervical chain

Efferent vessels of retropharyngeal glands

B

Fig. 11

A. Principle lymph node groups of the head and neck (Courtesy Taylor and Nathanson Oxford University Press, 1942 "Lymph Node Metastases")

1–4	Submental Nodes	19	Subparotid Node
5–9	Submaxillary Nodes	20	Subdigastric Node
6, 7	Mid-mandibular Nodes	21 22	Bifurcation Node
10–13	Preauricular Nodes	23	Omohyoid Node
14 15	Mastoid Nodes	24 25 29 30 31	Supraclavicular Nodes
16, 17	Occipital Nodes	26–29	Deep lateral chain
18	External Jugular Nodes	29 30	Transverse Cervical Chain
19–25	Internal Jugular Nodes	31	Subclavian Chain
		32 33	Anterior Deep Nodes

B Lymphatic drainage from the pharynx (Poirier and Charpy)

change. Palpation reveals a hard nodule beneath the mucous membrane which on biopsy may prove to be cancer

TRISMUS (LOCKING OF THE JAWS)

Trismus is not an uncommon complication of diseases about the mouth and jaws often associated with an acute inflammation producing spasm of the pterygoid or masseter muscles Metastases into the pterygoid (subtemporal) fossa or marked scar tissue after radiation of cancers also may cause trismus. Cancers of the buccal mucous membrane, anterior pillars, tonsils, or tumors of the ascending ramus of the jaw sometimes cause the jaws to be fixed or at least to be reduced in motion. Trismus should always arouse suspicion of malignant invasion of the pterygoid fossa, unless definite signs of inflammation or injuries are evident.

EXAMINATION OF THE NECK

Inspection reveals visible changes in the color surface irregularities (puckering, pig skin appearance) or swelling It is important to remember the normal anatomical landmarks of the neck, as the jaws, the submental region, the angles of the jaws, the sternomastoid muscles the carotid sheath thyroid cartilage, hyoid bone and the styloid processes, which in thin people may be palpated, particularly when long The examiner must constantly be cognizant of the number and location of lymph nodes in the neck. Figure 11 A and B illustrates the intricate network of lymphatics of the face scalp, mouth pharynx, and larynx, and the large number of lymph nodes capable of receiving cancer cells from these areas. Retrograde lymphatic metastases occur in a sufficient number of patients to demand routine examination (palpation) of all node-bearing areas. It is equally valuable to bear in mind the congenital anomalies and pathological lesions which may occur in various sites.

Sitting in front of the patient, palpation of the neck begins at the angles of the jaws first on one side, then on the other (Fig 12 A) The hand is passed down along the carotid sheath at the anterior edge of the sternomastoid muscle to the suprasternal notch. The submaxillary triangle and floor of the mouth are palpated between the index finger of one hand in the mouth and the fingers of the other hand beneath the jaw (Fig 12 B) The left floor of the mouth is palpated with the left index finger and the right floor of the mouth, with the right index finger The posterior triangle of the neck is then palpated from the sternomastoid muscle back to the trapezius muscle, and from the mastoid process to the clavicle.

The examiner then stands behind the patient, so that the contents of the anterior portion of the neck are palpated against the transverse processes of the vertebrae, as shown in Figure 12 C Often tumors along the cartoid sheath, particularly high in the neck, missed by palpation from the front, are detected in this manner Figure 12 D shows the technic of palpation of the neck from the back using both hands. With the right hand on the right side of the patient s neck and the left hand on the left side, both sides are palpated simultaneously for better comparison.

BIOPSY

The diagnosis of any tumor cannot be accurately made without microscopic examination. Biopsy is the removal of a piece of tissue from a living subject for microscopic study The material for histological examination is obtained from a tumor in one of three ways surgical excision, removal of a piece with biopsy forceps from a surface ulceration or aspiration of a bit of the tumor through a large needle. The pathologist can render an accurate decision only if an adequate amount of tissue typical of the disease is removed and presented to him in satisfactory condition It is important to secure a portion of the growing edge of the tumor where it is in contact with normal tissue giving an opportunity for the pathologist to study the relationship between the abnormal and the normal structures. Frequently tissue removed from the center of an unulcerated nodule deep beneath the surface



Fig 12. Method of examining the neck and floor of the mouth for enlargements of lymph nodes.

A Palpation of neck from in front. It is of advantage to have the patient tip the head slightly forward to relax the muscles of the neck.

B Bimanual palpation of the floor of the mouth and submaxillary triangle

C Palpation of the neck from the back using one hand

D Palpation of neck from the back using both hands.

is so macerated by autolysis because of lack of blood supply that an accurate histological study is impossible. Granulation tissue and slough in the center of an ulcer often overlie the neoplasm preventing the removal of a specimen representative of the disease. Infections always abound in the mouth pharynx, and larynx, often rendering satisfactory biopsy difficult Occasionally patients have the clinical signs and symptoms of cancer yet repeated biopsy of the ulcer reveals only inflammatory granulation tissue. This is especially true of lesions in the nasopharynx. Many months may elapse before the true nature of the disease is determined At other times, the diagnosis is made only by the removal of a non-infected lymph node.

Unless the signs and symptoms of acute infection are definite, a nodule in the neck, no matter how small or large, which has persisted beyond two or three weeks should be biopsied Small nodules are removed in their entirety Should the tumor or node mass be large, a piece is excised and the wound sutured or an aspiration biopsy may be satisfactory

Persistent ulcers, following adequate irradiation therapy of an ulcerated growth, require biopsy to determine the presence or absence of the original disease Radiation scars often break down months or years later This secondary ulcer may represent regrowth of dormant neoplastic cells or necrosis due to obliterating endarteritis the latter is common in the mouth where infection abounds, or on the skin following trauma. The choice of treatment of these delayed necroses or regrowths is governed by biopsy for accurate diagnosis.

EXCISION BIOPSY

The excision of a wedge-shaped piece of tissue from the edge of an ulcer gives a satisfactory specimen for microscopic examination. Such an operation must be carried out under local anesthesia. The wound may require closing with one or two black silk sutures for hemostasis or bleeding may be stopped by pressure or electrodesiccation or chemical cauterization Excision of a small subcutaneous nodule or lymph node or a piece of a larger tumor which is non ulcerated is carried out as a regular surgical procedure with sterile aseptic technic. The skin is closed in the usual manner with suitable sutures.



Fig 13 Biopsy forceps

FORCEPS BIOPSY

Biopsy of ulcerated tumors rather far back in the oral cavity by the scalpel excision method is often difficult and cumbersome. Adequate specimens are obtained with biopsy forceps as pictured in Figure 13 One or more pieces of tissue are bitten out of the edge of the tumor and dropped into 10 per cent formalin solution Bleeding, not a serious complication, is usually controlled by pressure or chemical cauterization or electrodesiccation Specimens for histological study are obtained from ulcers on the surface of the body with biopsy forceps.

ASPIRATION BIOPSY (NEEDLE BIOPSY, PUNCH BIOPSY)

Martin and Ellis (1934) described aspiration biopsy as a means of obtaining tissue from deep-seated non ulcerated tumors. This technic has been used extensively in some clinics, especially the Memorial Hospital for Malignant and Allied Diseases, in New York. The equipment consists of a small spear pointed scalpel, a 20 cc. Luer Lock syringe, a long 18 or 16 gauge needle, and an obturator for the needle A needle serrated at the end cores out tissue more readily than a bevelled needle

The skin overlying the tumor is sterilized as for any minor surgical procedure, and a weal raised by the injection of one percent novocain or procaine Further injection of the anesthetic solution down to the tumor edge helps to reduce pain. A tiny incision is made in the skin with the spear pointed scalpel The aspirating needle, equipped with obturator, is then inserted into the tumor The obturator is removed and the syringe applied to the needle. Some syringes are equipped with a lock securing the piston and permitting the easy maintenance of a partial vacuum While traction is made on the piston creating suction, the needle is forced further into the tumor and turned to core out a bit of tissue. The direction of the needle is changed through an arc of about 30 or 35°, and the needle forced further inward, cutting off the distal end of the core of tissue Gradually the needle is withdrawn, still maintaining the partial vacuum. As the point approaches the skin the vacuum is slowly reduced by unlocking the plunger and letting it descend slowly into the syringe, so as not to force the specimen back into the tissues, also preventing the specimen from being aspirated into the syringe and possibly lost The needle is then withdrawn and the specimen forced out onto a sterile slide or into a small vial of 10 percent formalin solution

There are certain advantages and disadvantages of this technic. We feel it has a limited use in the aspiration of tissue from rather large tumors where it is suspected that the tumor tissue itself is of such a consistency that it can easily be cut by and retained in the needle while being withdrawn. Dense fibrous tissue tumors have not yielded to aspiration biopsy well in our hands. Apparently the dense fibrosis does not allow the needle to cut through it satisfactorily and still permit the specimen to be retained in the needle Many pathologists object to aspiration biopsy on the grounds of the insufficient amount of representative tissue obtained The removal of a lymph node under local anesthesia through a small surgical incision is such a relatively simple and harmless procedure and at the same time gives a more adequate amount of tissue for study, that we prefer it, as a general rule, to aspiration biopsy Another objection to aspiration biopsy is that occasionally cells are spilled along the line of the needle causing subsequent implants.

SURGICAL MANAGEMENT OF NEOPLASMS OF THE HEAD AND NECK

The surgical treatment of neoplasms of the head and neck has improved along with the development of surgery in general, but there is still much to be desired. At the end of the last century, surgery of malignant disease yielded a poor prognosis. With the advent of x ray and radium therapy, the medical world had high hopes of greatly increased percentages of cures of cancer, especially of accessible neoplasms where radical surgery produced disfiguring and often incapacitating results. These hopes are realized in part for many tumors are palliated only and a too small number survive the five year period following adequate irradiation Some cancers of the face lips, and anterior part of the mouth are eradicated by irradiation, with or without mutilation. However, radiation therapy falls short of the anticipated percentage of cure. Moderately radio-sensitive tumors shrink following irradiation and are removed surgically Other cancers require such large doses of radiation therapy that immediate or late sequelae develop as radio-osteonecrosis, sloughing of the scar in the mouth subsequent to secondary infection (sore throat or infected teeth) that surgical removal of the

necrotic tissues becomes imperative shortly after the irradiation or at some later date. It is quite obvious, then, that in many cases irradiation and surgery are combined to eradicate the disease and to shorten the period of convalescence or on the other hand, to hasten the repair of damage brought on by the necessarily heavy irradiation required to destroy the cancer Fortunately advances in surgery have made it possible to perform extensive operations about the head and neck that twenty or thirty years ago were unheard of or if tried, were associated with high mortality These developments in surgery fall into seven important classes.

Preoperative irradiation of malignancies about the oral cavity and accessory sinuses has the following advantages

Radiosensitive neoplasms are often eradicated by irradiation, saving prolonged hospitalization and often mutilation requiring a series of plastic procedures for correction.

Moderately radiosensitive growths are reduced in size and vitality making operative removal easier and safer The cancer and often neck metastases are surrounded by dense scar tissue walls so that operation can be performed without encountering active viable tumor cells

This opinion is based on the experience of George Gey (personal communication) who found that tumors that grow readily in tissue culture when irradiated in situ show a poorer growth response provided the dose is near the threshold lethal dose clinically

Preoperative irradiation increases the vascularity of the tissues immediately after treatment and is followed by scar tissue, often obliterating the fascial plane Obliteration of the fascial planes makes it difficult to follow lines of cleavage during resection such difficulties, however are far outweighed by the increased safety of operations and the reduced size of the tumor

After the temporary erythema obliterating endarteritis sets in, closing capillaries and smaller vessels, resulting in avascular tissue The endarteritic process affects the larger vessels, also causing sclerotic walls without obliteration of the lumen As a result these sclerotic blood vessels become stiff and "pipe-stem" in character A paradoxical situation results namely an avascular scar bleeds briskly because the severed vessels have lost their contractility The dense perivascular fibrosis adds to the rigidity of the tissue. Electrosurgery offsets the increased bleeding by sealing some vessels while cutting and by coagulating larger vessels through hemostats or a ball coagulator

Cases for preoperative radiation are selected carefully to avoid complications as pointed out in Chapter XIX on metastatic lesions of the neck Often, delayed postoperative healing is brought about by preoperative radiation. The subcutaneous fat is atrophied and the skin has lost much of its normal vascularity Wounds about the mouth and neck easily become infected Radiated tissue has a markedly lowered resistance to infection. Heavily radiated tissue therefore, is a surgical hazard and must be reckoned with in the pre and postoperative planning and care. Operations on radiated tissue about the oral cavity are attempted with caution and preferably after the skin flaps are lined with split thickness or full thickness grafts to form a lining for the mouth at the time of the closure following the radical surgical procedures. Further discussion of this complication will be given in subsequent chapters.

ANESTHESIA

A hundred years ago anesthesia greatly enlarged the field of surgery and in recent years has made tremendous strides. Inhalation anesthesia has always been difficult to administer to patients undergoing operations about the head particularly the face and mouth Pentothal sodium, intravenously has made it possible for the surgeon to be relieved of the annoying anesthetic apparatus necessary in giving inhalation anesthesia. Intratracheal anesthesia, also is a great asset in carrying the patient along smoothly and safely permitting the anesthetist to control gas and air inhaled and exhaled without a large amount of cum

bersome apparatus about the head Intratracheal anesthesia allows the nasopharynx and hypopharynx to be packed with gauze preventing the aspiration of blood and particles of tissue or bone or teeth which might give rise to postoperative pneumonia or lung abceases, etc. complications which formerly were common following oral operations.

TRACHEOSTOMY

Extensive operations about the mouth and neck often produce edema of the hypopharynx and/or larynx with serious and sometimes fatal interference with respiration. It has become routine in many clinics including our own, to perform tracheostomy in all cases where there is likelihood of obstruction to exchange of air to and from the lungs after operations such as resections of jaw together with floor of mouth and tongue with or without neck dissections extensive neck dissections composite operations (see Chapter XIX) radical excision for carcinoma of thyroid laryngectomy radical excision of cervical esophagus, etc.

The tracheostomy is done at the beginning or end of the main operation as indicated by the immediate problem. When performed at the beginning of the operation the anesthetist inserts a rubber tube into the tracheostomy tube for purposes of anesthesia.

Tracheostomy is a short and non-shocking operation, adding no material risk to the patient and giving great security to life during the operation and postoperative period.

ANTIBIOTICS

Infection has always been a great danger in surgery of the head and neck The mouth is constantly contaminated by bacteria a ready source of both postoperative local infection and extension of sepsis into the neck and lungs Systemic infection formerly frequently followed operations on the head and neck Modern antibiotics such as sulfa drugs, penicillin and streptomycin have almost eliminated the danger of postoperative infection in the operative field chest and blood stream

ELECTROSURGERY

Because of the vascularity of the tissues about the oral cavity and face, the hemostatic properties of electrosurgical currents now make it possible and safer to remove much larger neoplasms than ever before. The small operative space prevents the application of a large number of hemostats Any technic, therefore,

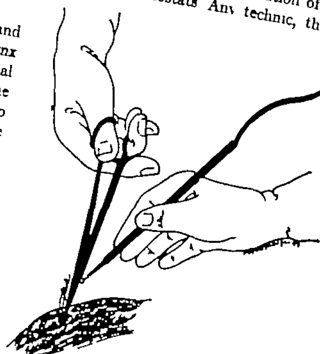


Fig. 14 Clamp coagulation method of hemostasis. Blood vessels are picked up in hemostats as usual and when it is desired to bring about permanent hemostasis, each clamp is picked up separately by the operator or an assistant and touched with the active electrode carrying a coagulating or strong cutting current. Great care must be exercised that all blood is wiped away from the tip of the hemostat and that the hemostat does not touch nearby tissue or instruments thereby shunting the current and causing a burn or poor coagulation from dissemination of the current through a clamp

which limits the number of instruments required, especially in the mouth, greatly facilitates operative procedures.

Electrosurgical cutting currents increase the ease of dissection of adherent tumors of the neck particularly metastatic nodes which have been preoperatively irradiated. Ward's clamp coagulation method of hemostasis makes it possible to control hemorrhage from vessels which often cannot be tied (Fig 14) Especially is this true of vessels deep in the antrum or far back in the mouth or other almost inaccessible places. This technic enhances the completion

of hemostasis when large numbers of hemostats are placed upon blood vessels in the skin and fascia of the neck.

NUTRITION

Scientific medicine has improved our knowledge of the nutritional needs of the body. Patients who can take adequate amounts of food and fluid by mouth, present no serious postoperative nutritional problem. Until recent years, postoperative nutrition was difficult to maintain following extensive operations on the mouth, tongue, lips, or jaws, both because of the mechanical difficulty of swallowing and because we did not know how to feed these patients adequately either parenterally or by tube feeding. Many patients actually starved to death. Modern knowledge of nutritional requirements of vitamins, minerals, and electrolytes, as well as proteins, fats, and carbohydrates, and the development of methods of administering these required foods to patients parenterally by tube feeding or occasionally by gastrostomy has made it possible to keep them on a perfectly normal food intake throughout postoperative convalescence, even though unable to swallow. Often, as suggested by Hayes Martin (personal communication) the patient is taught to pass a catheter down below the level of the epiglottis and feed himself at regular intervals. Some patients prefer to follow this procedure rather than carry an intranasal tube for hours or days at a time. Intranasal feeding or catheter feeding by the patient himself rarely necessitates gastrostomy.

PLASTIC REPAIR AND PROSTHESES

The rehabilitation of patients who have had extensive lesions about the head and neck destroyed by irradiation or removed by radical surgery has been enhanced greatly in recent years by advances in plastic surgery and the manufacture of comfortable efficient prostheses. Chapter XXI is devoted to this problem. Modern methods of rehabilitation make possible planning for the removal of extensive growths from the head and neck, including portions of the jaws, with the expectation of restoring the patient to fairly normal function and comfort. Some plastic procedures are performed at the time the neoplasm is removed, others are delayed until there is reasonable assurance that the cancer will not regrow, or until the tissues are ready to receive skin flaps from other portions of the body. Time is necessary for increased vascularity to develop sufficiently to support a graft. Delayed skin flaps are particularly advantageous after the tissues have been heavily irradiated. Frequently it is impossible to replace all the bone and soft tissues that are removed, for example, the hard palate or superior maxilla. Prostheses, often carrying teeth, permit the patient to swallow and talk normally. In suitable cases a temporary prosthesis is inserted in the mouth prior to operation (guide planes) to maintain the position of the jaw fragments until the operative wound is healed and a permanent prosthesis can be fitted. In other cases, a temporary prosthesis is worn until plastic operations, including transplantation of bone, are permissible, completely rehabilitating the patient. The hope of plastic reconstruction or the adaptation of a properly fitting prosthesis gives the surgeon courage to perform, and the patient fortitude to undergo, operations which only a few years ago were almost unheard of.

ELECTROSURGERY

After a generation of development, electrosurgery has taken its place as an indispensable weapon in the surgeon's armamentarium. "Electrosurgery is the application of high frequency alternating electric currents for the destruction and removal of pathological tissue or for the cutting of normal tissues to approach a disease area with diminished bleeding." (Kelly and Ward, 1932.)

HISTOLOGICAL CHANGES DUE TO ELECTROSURGICAL CURRENTS

Desiccation, as its name implies, is the dehydration of tissue. Under the microscope, parenchymatous cells appear dried out and shriveled and elongated, but their cellular characteristics are discernible, namely, *nuclei*

cell walls, protoplasm etc. Electrodesiccation is produced by cooler (or weaker) currents, generated either by spark gap or vacuum tube apparatuses. It is not so important that the current be uniterminal or biterminal, but rather it is the size of the wave length and other factors in current balance which make for slow heating so essential for good electrodesiccation

Coagulation, as its name indicates is actual boiling of the tissue cells in their own juices. Coagulation is accomplished by a hotter and stronger current than desiccation, either from a vacuum tube or spark gap generator The parenchymatous cells are coagulated into granular masses while the stroma appears hyalinized with here and there remnants of coagulated blood vessels and contained blood.

Electrosurgical cutting (Electrotomy—Blech 1938) is produced by a carefully balanced high frequency electric current, generated from either a spark gap or vacuum tube apparatus Tissues are severed in advance of the electrotome be it a needle wire loop or small knife blade The cutting is due to the current and not to the size or shape of the instrument carrying the current By carefully altering the physical characteristics of the wave length voltage and amperage, cutting currents are generated to sever tissue with only $\frac{1}{10}$ mm. destruction on each side Such slight tissue damage allows primary union in a rather high percentage of cases. Ellis (1931) has shown that these electrosurgical scars are weaker than scars of ordinary scalpel surgery After many years of experience we feel that the value of such fine cutting is questionable and no longer use it for severing normal skin. It is valuable for delicate dissection of tumors adherent to periosteum, large arteries, and between adherent loops of intestines.

Electrosurgical cutting with deeper destruction on each side of the incision (1–2 mm.) is of unquestionable value in excising malignant disease from vascular areas, since capillaries, small blood vessels, and lymphatics are closed. These strong electrosurgical cutting currents are generated either by spark gap or radio tube apparatuses Primary union of course is out of the question but really not desired, since these heavy destructive currents are intended to sterilize the wound of cancer cells as the neoplasm is removed Occasionally the coagulated tissue left by the current may be excised with the scalpel allowing primary union.

NOMENCLATURE

(The words *cautery* and *cauterization*, as applied to electrosurgical effects, are incorrect. When properly applied electrosurgical currents do not actually cauterize Occasionally cauterization occurs with active bleeding into the surgical wound. Unfortunately, these terms are still used rather glibly in describing electrosurgical procedures)

Technical Procedures. We are indebted to Gustavis M Blech (1938) for some of these terms

Electrotomy describes electrosurgical cutting and is defined as fine or coagulating depending upon the intensity of the current and the depth of penetration

Electrodesiccation is the dehydration of tissue to the point of destruction

Electrocoagulation is the coagulation of tissue by strong high frequency currents which actually boil the cells in their own juices. Coagulation may be superficial or deep

Instruments (Fig 15) *Electrotome* is an electrosurgical active electrode for electrotomy or cutting of tissues. The electrotome may be made in the shape of a blade, wire loop, curette or needle

Desiccator and coagulator can be a ball a disc, or a needle

Electrosurgical curette is a curette which carries a high frequency electrical current and coagulates and controls the hemorrhage as the tumor is removed piecemeal.

Electrosurgical snare is often used to surround the base of the pedicle of a tumor An ordinary tonsil snare with insulated shank is satisfactory The current carrying electrotome or coagulator is touched to the snare handle the current running down the handle and through

the snare, controlling the bleeding as the snare passes through the pedicle or base of the tumor

Electrosurgical rongeur carries the current to coagulate the organic tissues in bone, as the bone is bitten away

Active electrode is the electrode (Fig 15) which condenses the high frequency current at the point of contact It is the smaller of the two electrodes and the concentration of the current causes the electrosurgical effect

lesion is deep the needle electrode should be touched to the surface

A wart requires the needle to be inserted repeatedly at the proper depth (through epidermis only) at the edge of the wart where the tissues are moist enough to carry a current and also completely through the wart to its base. The wart surface is so dry that it will not carry a current. The needle is moved from place to place until the wart is completely surrounded

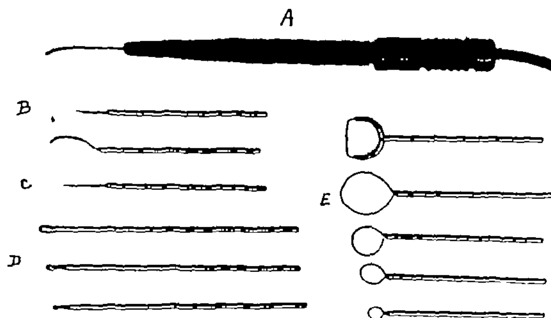


Fig. 15 Assortment of active electrodes for electrosurgical operation

A. Insulated handle to hold electrode.
B Flat electrotomes.
C Needle for electrotomy desiccation, or coagulation.
D Ball coagulators
E. Loop electrotomes (curettes) (From Kelly and Ward. Courtesy W B Saunders & Co)

Inactive electrode is the large electrode placed at a suitable spot on the skin. The current is so widely disseminated that pain and heat destruction are eliminated

SURGICAL TECHNICS AND OPERATIONS

Desiccation is usually done by light uniterminal currents and is used for the destruction of small skin lesions such as benign moles, warts and epitheliomas and, occasionally for small hemangiomas. In treating very superficial lesions (hyperkeratoses) a light spark is sprayed over the surface The desiccated tissue is scraped off and the base re treated If the

and dehydrated It is then scraped off and the base re treated A mole likewise is circumvallated, a technic described by the late William L. Clark, of Philadelphia The needle electrode is inserted repeatedly in the normal tissue at the edge of the mole and carried through all layers of the skin into the subcutaneous fat This blocks off lymph and blood drainage through the skin the main mass of the mole is then destroyed. Electrosurgical destruction of moles is limited to small benign ones less than a centimeter in diameter Malignant moles either should be excised with a strong electrosurgical cutting current and the base thoroughly

treated, or excised with a wide margin with a scalpel and sutured (See Chapter IV)

Coagulation may be accomplished by needle, ball or disc coagulator In the destruction of large tumors, Clark's circumvallation technic is employed wherever possible. A needle coagulator is inserted repeatedly around the edge of the tumor in the normal tissue, remaining in each place until a ring of white coagulation appears around the needle After the entire tumor is circumvallated its main mass is attacked, either by the ball disc, or needle coagulator The more superficial areas are destroyed by a ball or disc, and the deeper structures are better treated with the needle electrode, penetrating to the desired distance The coagulated layer of tissue is curetted away and the base re treated and so on until the entire tumor is destroyed Less accessible tumors, located in the antrum bladder or oral cavity, may not lend themselves to circumvallation and may have to be attacked directly by a suitable coagulator in repeated steps of coagulation and curettage.

Electrosurgical aspiration Wet surgical operative fields are kept dry by a suitable aspirator When active bleeding is encountered the tip of the aspirator is pressed against the bleeding point and the active electrode applied to the aspirator Special aspirators have been devised with sterilizable wire cable connected, the current being turned on as desired, either by a foot switch or a switch in the aspirator handle itself

Hemostasis. The hemostatic property of electrosurgical currents makes them of great usefulness in the surgery of malignant disease.

Clamp method During any surgical procedure, hemostats are applied as needed to control bleeding. When it is desired to bring about permanent hemostasis the hemostats are picked up one-by-one and touched with the active coagulator (Fig 14) This technic was first described by Ward (1925) The current passes down the hemostat to coagulate the vessel caught in its grip When a small area of coagulation appears around the tip of the hemostat, the current is turned off and the instrument removed A word of warning While applying the current, the hemostat must not be allowed to touch another instrument or any tissue except that held within its jaws, as the current will be shunted away with resultant inefficient hemostasis of the vessel or a burn of normal tissue touched nearby Also blood clots around the tip of the clamp must be removed by a sponge or aspirator before applying the current

Hemostasis is also obtainable with a ball or disc coagulator which is applied to the bleeding points before turning on the current the pressure stopping the flow of blood so that the current when switched on will coagulate the compressed vessel more quickly If the vessel is not first occluded the flowing blood retards coagulation and allows charring and undesirable destruction of nearby tissues

Control of oozing General oozing from a vascular wound is often annoying and difficult to control by the direct application of a ball or disc coagulator to the bleeding surface. The rapid flow of blood covers the coagulator, the blood boils, and much charring results without complete and accurate control of hemorrhage To avoid this messy situation, the oozing surface is covered with a gauze sponge under pressure. As the sponge is gradually moved across the oozing surface, it is followed by a ball or disc electrode applied to the partly exposed area, coagulating to the desired depth leaving a dry sterilized wound.

Electrotomy (electrosurgical cutting) may be fine, that is, slight tissue damage on each edge of the incision ($\frac{1}{10}$ mm), or coagulating that is, deeper destruction on each edge of the incision (1–2 mm) The former, when employed for skin incision allows primary union in a fairly high percentage of the cases (85 per cent) (Ellis, 1931) The value of this type of electrotomy is questionable. Coagulating electrotomy is of inestimable value in removing tumors from vascular and wet beds, as the mouth, cheeks brain urinary bladder, etc., and oftimes in dissecting subcutaneous tissues in turning back skin flaps in the neck. The strength of the current is regulated to produce

any desired depth of destruction from a fraction of a millimeter to 2 mm as required by the vascularity and type of tissue encountered Fascia of the neck with little fat is easily severed with a weaker current than is necessary in dissecting the fascia of the breast which is heavy laden with fat. The fat melts under the heat of the current making a somewhat wet field, the fluid fat disseminating the current and reducing cutting properties thus the need of a strong current to offset this dissemination In vascular fields such as encountered with hemiglossectomy a strong current is required to coagulate all but large (1 mm) vessels during operation. Vessels larger than 1 mm are clamped and coagulated.

Anesthesia. Anesthesia for electrosurgery varies with the type of operation. Injection of novocain procaine or any other suitable local anesthetic suffices for the destruction of smaller benign lesions on the lips skin and accessible areas of the mucous membrane The solution should be injected at a distance well around the lesion for the current will penetrate rather far out and may cause pain beyond a narrow area of anesthesia. It goes without saying that explosive freezing mixtures, as ethyl chloride, are dangerous and never should be employed. Also since electrosurgical effects are caused by *heat generated by the current passing* through the tissues, the frozen area will be thawed out and its anesthetic property lost before the current effects take place.

General Anesthesia. Experience has taught that no explosive mixture of gas anesthetic should be employed in a closed system when using electrosurgery One of the most explosive mixtures is nitrous oxide, oxygen, and ether Non-explosive gaseous mixtures as nitrous oxide and oxygen in a closed system are safe Open drop ether is likewise safe when the head of the patient is protected by a screen and the operation is on the trunk or extremities.

A satisfactory method of anesthesia for electrosurgical operations about the head and neck is as follows

Basal anesthesia of intravenous sodium pentothal is begun and continued slowly during the operation, supplemented by inhalation of nitrous oxide and oxygen, given through a closed system as the mixture is not explosive. Curare is of great aid in relaxing the patient and reducing the amount of pentothal required Under this combination of pentothal sodium with curare and nitrous-oxide-oxygen mixture, properly administered electrosurgical procedures may be carried on for several hours. The maximum amount of pentothal sodium to be given within the limits of safety is 2 gm.

The operating table should be grounded at all times to prevent the accumulation of static. The operator and assistants too should have non insulating soles on their shoes.

Postoperative care. The postoperative care of electrosurgical wounds differs from ordinary surgical wounds because of the presence of destroyed tissue which is not always completely removed If the wound is left open secondary infection is apt to occur and must be treated.

For a minor electrosurgical procedure the care is rather simple. Desiccation or coagulation of small lesions on the surface leaves a dry sterile scab to be treated like any other small burn. An acetone (10 percent)-alcohol (50 per cent) solution of gentian violet 2 per cent (Bohlman s solution *Personal communication*) suffices to form a firm crust or scab which comes *away in three or four weeks, depending upon* the depth of destruction leaving a pink slightly depressed scar which gradually becomes almost imperceptible Should any infection develop beneath the scab it is removed and the area treated appropriately

If electrosurgical procedures are carried on deeply in the body and the wound is closed per primum healing is expected and the care of the patient and wound is the same as following any other similar operative procedure. Special attention is needed, however when wounds, of necessity are allowed to granulate, or where there is extensive destruction about the head interfering with intake of food and fluids and perhaps with normal respiration Every possible precaution should be taken to keep infection of these sloughing and granulating areas at a minimum Antibiotics, parenterally orally or

locally, are of great advantage, as mentioned above.

Good antiseptic dressings applied at the operating table are allowed to remain for from one to several days, depending upon the circumstances. If the drainage from the oral cavity is considerable, the dressings should be changed frequently, either daily or several times a day, as indicated. This frequent change of dressings not only takes away drainage, saliva, and serum from mouth and wound, but also carries away slough and coagulated tissue, hastening granulation and healing.

Large defects in the oral cavity or sinuses are kept clean by packing with iodoform gauze, changed after appropriate intervals. Also large, warm saline solution douches make the patient more comfortable and wash away coagulum and slough as they loosen. Nutritional attention is of vital importance and has been stressed under the section above, on surgery.

HEALING OF ELECTROSURGICAL WOUNDS

Except when fine cutting currents have been used in the skin, rarely do electrosurgical wounds heal per primum. Following electrodesiccation of small skin lesions, the scabs come off in from two to four weeks, depending upon the depth of destruction. The remaining scars are soft and pliable, pink, at first, later fading out and becoming usually slightly noticeable. The amount of deformity depends entirely upon the depth to which the tissues have been destroyed and the size of the original lesion. Superficial lesions limited entirely to the epidermis, as hyperkeratoses and warts, heal about like any other second degree burn. Benign moles and epitheliomas, requiring destruction of all layers of the skin down through the dermis, leave a slightly deeper pit or a little thicker scar, should there be a tendency to keloid formation. Keloids are rarely a problem.

Larger electrosurgical wounds heal slowly and by secondary intention, since slough must come away and granulations develop. The scars of these granulating wounds are soft and pliable, the disfigurement being remarkably slight in comparison to the amount of tissue taken away. Particularly is this true about the eyes. Apparently the skin contracts slowly and ectropion and entropion are rare following electrosurgical wounds, in contradistinction to scalpel wounds of like magnitude about the eye. Scalpel wounds of similar size to those left after electrosurgical removal of malignancy from the eyelids require skin grafting or shifting of grafts to close without deformity of the lids.

Also around the nose electrosurgical wounds heal satisfactorily, gradually pulling the skin edges more closely together with slight defect, *often assuming the normal wrinkles and lines* of the face.

About the mouth large wounds require plastic repair. A reasonable length of time, four to six months, should elapse to assure against recurrence. Unlike the scars following heavy irradiation, electrosurgical scars are vascular and soft, permitting plastic repair much more readily. The vascular soft tissue readily receives skin grafts of one kind or another after removal of the scar itself.

RADIATION THERAPY OF TUMORS OF THE HEAD AND NECK

by John C. Gleson, M.D.

There are a number of general principles governing radiation therapy that are important in considering the diagnosis and treatment of tumors of the head and neck. It is self-evident that there is no substitute for thorough training in the use of radiation therapy. This brief discussion is not intended to be an instruction in radiation technics and doses, but rather a reminder for those who are already acquainted with them, and a guide for those not familiar with radiation therapy.

The efficiency of the application of radiation therapy or surgery in the treatment of a specific lesion is as important as the choice of the modality for the case in hand. There are cases in whom one method is preferable to another

or in whom a combination of radiation and surgery offers more than either alone. Modern day therapy of tumors both benign and malignant, requires complete cooperation amongst surgeons, radiologists and pathologists. A lack of such unity of effort, either ignorantly or selfishly is responsible for many failures as is the improper application of the method or methods chosen for the treatment

Adequate radiation therapy equipment is essential for best results. It is folly to use portable or diagnostic apparatus in the treatment of malignancies. More commonly energies of 100 Kv to 400 Kv are used, depending on the type and location of the tumor to be treated Equally important is the availability of proper and adequate accessory equipment, as cones or localizers, shields, and other aids for properly directing and defining the x ray beam and stretchers, dental-type chairs and other pieces of furniture aiding the proper positioning of the patient. The periodic calibration of the equipment is necessary Proper safety precautions, both for the professional staff and patient must be rigidly observed at all times.

Radium and radium emanation (radon) frequently are required for treatment of malignancies, in conjunction with x-rays and/or surgery Training and experience only can qualify the clinician for their intelligent, coordinated use. Whenever these two agents are employed, proper safety precautions for the patient and the staff personnel must be constantly observed. Efficient treatment cannot be delivered without sufficient quantities of radium element or radon to allow proper distribution throughout the tumor Patterson and Parker and Quimby have set down rules for distribution of radiation sources and dosage quantities required for various volumes and surface areas. We use Quimby's Table (Table 1) in calculating interstitial doses in treating with radon.

A knowledge of the histological character of the tumor is mandatory before therapy is administered Only in unusual and extenuating circumstances are treatments *given without* histological diagnosis.

Radiation therapy is planned in conjunction with the surgeon when surgery is *contemplated* subsequent to radiation. It is necessary to preserve the integrity of as much surrounding normal tissue as is consistent with the eradication of the disease. With this consideration in mind, the therapy is somewhat different than it might be in patients in whom no surgery is to be done. In any event, unnecessary damage to normal structures is avoided, but where such damage in the field of radiation cannot be prevented, the needed dose of radiation is given. But when it is possible to avoid the loss of scalp hair eyebrows, eyelashes, or mustaches, without compromising therapy this is done Likewise the eyes, teeth nasolacrimal duct, mucous membranes, and other structures are protected as much as possible. It is desirable to prevent undue damage to bones, since radio-osteonecrosis frequently follows heavy radiation. By proper shielding of the area to be treated or by use of multiple ports damage to normal tissues is held to a minimum

One of the most important aspects of assuring the patient's cooperation in a series of protracted radiation treatments is to acquaint him with what the treatments are how they are carried out and what will happen to the tumor and what will happen to him. All too often physicians lose sight of the fact that doctors, hospitals, and above all a room full of noisy and massive machinery are frightening to the patient To some they are even terrifying A few moments of reassurance and friendly conversation make the patient much more receptive to the treatment

The patient should be advised in advance of the expected reactions in skin mucous membranes, or other structures (Fig 18 A and B) Before treating intraoral nasal, or pharyngeal lesions, the patient is informed that the mucous membranes will become sensitive and tender eating and drinking will be painful, the sense of smell may be affected and taste may be greatly altered He should also know that the saliva may become thick and tenacious and

the normal skin may undergo first or second degree damage, followed by a sequence of events similar to those after a like degree of thermal burn The term *burn* should never be used in the presence of the patient as it connotes unnecessary damage and often frightens the patient Edema of the irradiated tumor and the normal tissue surrounding it in often impressed by the apparent sagacity of the physician and confidence is assured. An experienced therapist is able to anticipate certain occurrences and, by his anticipation the patient's apprehension and welfare are planned for in advance

Every patient should be seen by the physician at each treatment and only in exceptional cir

TABLE 1

QUANTITIES OF RADIATION NECESSARY TO DELIVER SPECIFIED MINIMUM DOSES IN VARIOUS TISSUE VOLUMES

	INTERSTITIAL SOURCES					FILTER 0 3–0.5 mm Pt					
Dose in Gamma Roentgens	Diameter of Spherical Mass (CM)										
	1	1.5	2.0	2.5	3 0	3.5	4.0	4 5	5.0	5 5	6.0
	Volume of Mass (CU CM)										
	0.5	2	4	8	15	25	35	50	65	90	115
	Milligram- or Millicurie-Hours to Deliver Specified Dose										
1 000	35	80	135	250	330	420	540	680	830	1 000	1 160
2 000	70	160	270	500	660	840	1 080	1 360	1 660	2 000	2 320
3 000	105	240	405	750	990	1 260	1 620	2 040	2 490	3 000	3 480
4 000	140	320	540	1 000	1 320	1 680	2 160	2 720	3 320	4 000	4 640
5 000	175	400	675	1 250	1 650	2 100	2 700	3 400	4 150	5 000	5 800
7 000	245	560	945	1 750	2 310	2 940	3 780	4 760	5 810	7 000	8 120
10 000	350	800	1 350	2 500	3 300	4 200	5 400	6 800	8 300	10 000	11 600
	Millicuries Destroyed to Deliver Specified Dose										
1 000	0 25	0 6	1 0	1 9	2 5	3 2	4 0	5 0	6 2	7 3	8 7
2 000	0 5	1 2	2 0	3 8	5 0	6 4	8 0	10 0	12 0	15 0	17 0
3 000	0 75	1 8	3 0	5 7	7 5	9 6	12 0	15 0	18 0	22 0	26 0
4 000	1 0	2 4	4 0	7 6	10 0	13 0	16 0	20 0	25 0	30 0	35 0
5 000	1 25	3 0	5 0	9 5	12 0	16 0	20 0	25 0	31 0	38 0	44 0
7 000	1 75	4 2	7 0	13 0	18 0	23 0	28 0	35 0	43 0	52 0	61 0
10 000	2 50	6 0	10 0	19 0	25 0	32 0	40 0	50 0	62 0	75 0	87 0

(Reproduced from *Physical Foundations of Radiology* by Glasser Quimby Taylor & Weatherwax, Paul B. Hoeber Inc. *Table 35* p 310 With permission of the Authors and Publisher)

the path of radiation is not infrequent When he understands that symptomatically and visibly he may feel and appear temporarily worse than prior to therapy such preliminary assurance makes him more cooperative. It is exceedingly difficult to convince an uninformed patient that the pain and sharp skin reactions were expected and are a necessary accompaniment of adequate therapy But, having been fore warned, when these events occur they are *cumstances should anyone beside the physician be allowed to administer therapy*

When treating over bone, x ray films of the region are taken to determine the presence or absence of metastases or invasion by the tumor and to supply a basis for future comparison Before commencing the therapy skin ointments, salves, or other preparations are prohibited and if any such applications containing metals or halogens have been used, they are

carefully removed All adhesive tape on the planned treatment areas is removed and the skin washed with ether These precautions are necessary since the metal and halogens set up secondary radiations extremely caustic to the skin Halogens themselves are irritating in addition to the secondary radiations they produce, all of which adds to the damage from the radiation itself No discoloring substances are allowed for they obscure the limits of the tumor leading to the use of an inadequately small port they also may obscure early ery

contain no metal or halogens for the reasons already given Likewise, when it is necessary to administer radiation through dressings post operatively they are applied without adhesive tape, but with gauze wrapping or Scultetus binder which do not interfere with radiation therapy Scotch tape is much less irritating than adhesive and may be used

Neither the patient nor any other physician should prescribe treatment for the area under therapy without the consent of the radiologist. During the time of and following treatment





Fig. 16. Radio-osteonecrosis of right mandible following roentgen radiation of carcinoma of tongue, pull-through *composite operation (see Chapt 19) and radon implantation of recurrent metastatic lymph node in upper neck*
A. A P view prior to radon implantation. Surgical resection required
B Lateral view showing radon seeds.

thema a helpful guide to the radiation therapist It is our practice to instruct the patients not to bathe the skin to which the treatment is administered for several reasons. First, bathing includes the application of heat In many respects, x rays behave in the skin and deeper tissues much the same as heat Irritating substances, heat or ultraviolet light greatly intensify the action of x ray causing much more severe reaction than should ordinarily occur Clothing buttons jewelry bandages false teeth and other impedimenta are removed from the field of radiation

When radiation therapy is to follow surgery preoperative skin *antiseptic solutions must*

until the complete disappearance of the radiation reaction the radiologist solely is responsible for the care of the lesions.

Since the treatment of most malignant lesions in and about the mouth cheeks, and lips requires heavy doses of radiation the presence of teeth in the line of radiation is highly undesirable When it is not possible to properly protect such teeth they should be extracted prior to the radiation therapy the large doses required to destroy squamous cell cancer devitalize not only the bone in which the teeth are located but also the teeth themselves. X ray and radium in sufficient quantities to destroy cancer kills the osteoblasts of the peri-

osteum and initiates obliterating endarteritis rendering the bone more susceptible to infection Even should the teeth and bone escape infection during the course of therapy, the removal of the radiated teeth years later may result in the introduction of infection into the devitalized bone resulting in osteomyelitis which is extremely difficult to manage (Fig 16, A, & B) At times, it is advisable to remove teeth even when not in the line of radiation, in order to allow better accessibility to the tumor

Figure 17 is a roentgenogram of radio-osteoporosis, often confused with metastases to bone Differentiation is largely on a clinical basis. Radio-osteo-porosis is not uncommon after radiation of bones in many parts of the body skull long bones, mandibles, etc.

Close attention to nutrition during and after treatment is essential to prevent starvation and its attendant complications prolonging morbidity from the treatment or the disease, and delayed wound healing When any part of the mouth oropharynx or esophagus is to be treated, the patient should be informed that he will be unable to eat foods or drink liquids of extreme temperatures. Likewise, highly seasoned foods are avoided since they cause considerable pain Food and drink should be consumed at body temperature Generally, patients find that pureed infant foods are satisfactory Nupercainal tablets or other local anesthetics prior to mealtime provide sufficient relief from discomfort to allow consumption of enough food to maintain good nutrition Rarely is it necessary to feed through an intraoral or intranasal tube, or parenterally

Nausea or vomiting (radiation sickness) is rarely a complication of radiation therapy of tumors of the head and neck. However heavy doses of radiation used in treating large lesions on the scalp overlying brain tissue often produces cerebral edema and increased intracranial pressure, which may cause vomiting. High voltage penetrating rays should not be used in these cases because of the possibility of damage to the brain itself

Sharp skin and mucous membrane radiation reactions produced by cancercidal doses of x rays subside fairly rapidly The changes consist of an erythema beginning in about ten days following the onset of treatment The erythema, along with some edema, deepens and in about two weeks, vesication occurs (Fig 18, A and B) The vesicles rupture and desquamation ensues Then the deeper layers of the skin appear a bright glistening red, ooze a yellowish serum, and bleed easily Eventually the epithelium is denuded, leaving a raw, weeping



Fig 17 Radio-osteoporosis following radium application and roentgen therapy for carcinoma of tongue. No resection required.

surface the approximate size of the port. In four or five weeks, pigmentation appears in the surrounding zone and the treated area commences to epithelize from the periphery and from islands of epithelium in the desquamated region itself Healing usually requires six to eight weeks.

The prediction of reactions from cancercidal doses are matters of judgment and experience rather than of a purely mathematical calculation which is *hic ergo hoc* The sharp reactions of the mucous membranes begin to appear somewhat sooner than in the skin The reaction is one of erythema increasing in intensity and accompanied by edema followed by a whitish or yellowish white diphtheritic like membrane with intensely red borders, accompanied by

pain and tenderness, making mastication and deglutition difficult. Loss or change in taste is temporary returning to normal in a few weeks to several months. Generally these symptoms subside somewhat more rapidly than do those in the skin.

During the course of treatment all patients should be seen daily by the physician especially those receiving therapy to the oropharynx or larynx to detect troublesome or dangerous edema. The entire course of radiation should be delivered within a period of thirty calendar days except when treating tumors in the larynx or oropharynx where edema at times embarrasses respiration then it may be necessary to protract treatment to avoid swelling of the larynx or hypopharynx Tracheostomy prior to commencement of x ray therapy in advanced cases prevents respiratory embarrassment.

The radiation of skin lesions as a rule, is completed in a maximum of five to ten days Large lesions may require a reduction in the daily dose spreading the course over a period of approximately fourteen days Should the skin reaction become too severe treatments are spaced further apart

Healing of radiation reaction following treatment of skin malignancies usually requires a few weeks to two or three months, depending on the severity of the initial injury and the patient s individual response Care during this time is largely symptomatic. During treatment the discomfort of the radiation reaction is relieved by mild non irritating substances, as olive oil or plain petrolatum On completion of the active treatment other applications may be used. During the wet phase calamine lotion is applied at night and zinc ointment during the day Pain in the mouth is often controlled by nupercainal tablets or similar local anesthetics used prior to meals, thus allowing the patient to eat more comfortably The saliva may be loosened by slippery elm tablets. Codein is often prescribed to alleviate pain

Following healing of the wet phase the epithelium is tanned thin and atrophic The tanning usually disappears completely but slowly Hair is usually permanently epilated although occasionally there may be some re-

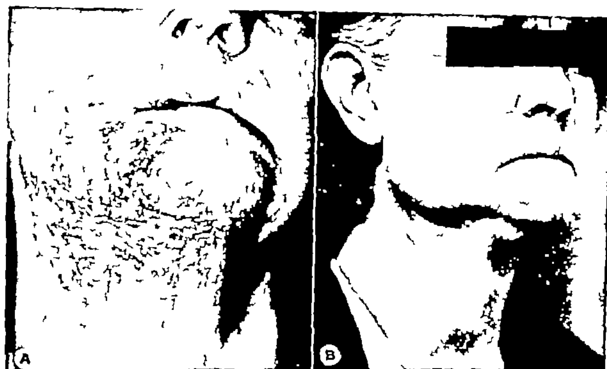


Fig 18

A. Roentgen radiation epithelitis in the desquamation stage
B Healed with moderate atrophy of skin and slight telangiectasis.

very Generally there is some recovery of the nction of the sweat and sebaceous glands, ith decreased secretions. Skin which has suf red such damage rarely can be expected to lerate repetition of a like injury Conse ently, any further treatment by means of diation is undertaken with great caution if all.

The atrophied skin appears parchment like in, dry scaly, and shiny, and is susceptible injury requiring the patient to exercise recaution in caring for such skin

Late results are of telangiectases, appearing about one year and indolent ulcers which rtunately are not common We have seen lcers develop in radiated areas as long as fteen years following heavy therapy The asic cause of these late sequelae is probably a irect result of and proportional to, the mount of the vascular bed affected by the ndarteritic process initiated by the radiation Ulcers occurring in radiation scars require ade uate biopsy to determine the presence of ersistent malignancy or the development of adiation cancer

Radical surgery may produce fibrotic hanges in the skin and subcutaneous tissues imilar to those following large doses of radia ion resulting in decreased ability to withstand arge postoperative doses of radiation Radia ion in these cases is undertaken with caution.

Radiation ulcers are painful and slow to heal ecause of the impaired circulation produced y the obliterating endarteritis their manage- nent is difficult, at best They may heal under xpectant treatment and bland ointments after a period of several months to one or two years. Radon ointment when properly used gives satisfactory results in some cases (Uhlman, 1939 Fricke and Williams, 1945) The under ying biophysical principles of the use of radon ointment would seem to us to be questionable, for one type of radiation is employed to cure an ulcer caused by a different type of radiation Observation of results over a long period of years is necessary for complete evaluation of the method. Aloe vera leaf or ointment and estrogen ointments are also of advantage in treating radiation ulcers. (Collins and Collins, 1935)

Radiation ulcers which do not heal promptly under medical management are surgically ex cised, especially delayed ulcers occurring months or years after radiation The line of excision must be in normal surrounding skin and carried deep enough to remove the injured tissue Suitable plastic procedures are then carried out to close the defect

Until the advent of modern-day high and supervoltage therapy skin tolerance limited deep therapy However, now that x rays gen erated at million and multimillion volt ranges are available, it is extremely important to bear in mind that at these higher voltages the energy is carried deeply into the body and that damage is not only in the skin as formerly, but in the deeper tissues. The absence of skin changes previously seen in lower voltage radiation does not mean that tremendously higher doses of supervoltage therapy can be administered with impunity

TEAM MANAGEMENT OF NEOPLASMS

The late Dr J M T Finney is quoted as saying that 'he who removes cancer of the breast should not be the one to close the wound' (Baltimore tradition) Sir Harold Gillies has aptly emphasized with the term *team surgery* what has been a fundamental principle in cancer therapy for many years He refers to the cooperation of all specialists necessary in the successful diagnosis and treat ment of malignant disease. It has been our policy for the last twenty-five years to co- operate intimately with the specialists who are familiar with the various surgical and thera peutic problems encountered in the treatment of diseases of the head and neck. This coopera tion means working together when necessary in the diagnostic clinic and at the operating table It also means that each specialist does his work at the appropriate time in the course of diagnosis, treatment and rehabilitation For this reason in our tumor clinics there is close cooperation between the general surgeons ra diologists pathologists, and plastic surgeons.

Other specialists as otolaryngologists, ophthalmologists, oral surgeons prosthodontists, and occasionally, neurosurgeons are called in consultation as cases demand It cannot be too strongly emphasized that all patients should be *carefully discussed with the appropriate* specialists at the beginning of their study and the course of investigation treatment and rehabilitation planned Plastic repair may be carried out at the time the cancer is removed Other cases require secondary plastic procedures of greater or lesser magnitude spaced at proper intervals. Much time, discomfort, and disfigurement are saved by proper prostheses, made in advance of radiation therapy or surgery to maintain bone fragments and soft tissue in as near normal position as possible during the course of the radiation therapy or following surgical procedures. It is obviously better for the patient s well-being to do as much plastic work as permissible at the time of the removal of the growth, or as soon after as feasible. Some extensive operations, however will not permit immediate closure and plastic procedures must be delayed accordingly At other times, preparation for plastic procedures takes several weeks or months, allowing time for the growth to extend beyond the limits which it held on admission. This is a hazard to the patient. During this waiting period a course of radiation therapy shrinks and devitalizes the growth. It is important that at all times everything should be done to maintain the patient s morale and keep him active and at work as much as possible, often for economic reasons.

FOLLOW UP AND STATISTICAL STUDIES

The proper management of patients afflicted with malignant disease in tumor clinic and private practice requires careful follow-up for two reasons the most important one being for the benefit of the patient. It is a generally accepted axiom that all patients with cancer should be followed for at least five years. During the first year after completion of the treatment and the wound has healed the patient is observed every month or two Often the physician will detect early signs of regrowth sooner than the patient and he also knows where to watch for possible metastases. Metastases may be curable when recognized early and properly treated *This follow-up is carried out by the* family physician when the patient lives at a distance from the cancer therapist or, if near at hand, the follow-up is carried out by the surgeon who managed the patient from the beginning During the second and third years, the follow-up need be only at intervals of three or four months After the third year the interval is lengthened to every six months.

To make the follow up efficient the patient is instructed regarding the need of repeated observations and their benefit to him, as well as the statistical and scientific value for the improvement of service to the public at large. We have found that private patients will co-operate and pay a small charge to cover the added overhead to the clinician In the clinics, an efficient secretary and follow up nurse and social worker are essential

The second reason for follow up is to determine the adequacy of methods of therapy in rehabilitating the patients and keeping them well. Careful follow up is a series of checks and balances to help in the improvement of diagnosis and treatment, as well as of scientific *interest in watching the progress of the disease* process.

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Chapter II

THE EARLY DEVELOPMENT OF THE HEAD AND NECK

By
Vernon E. Krahl, M S., Ph. D *

The positions and relationships of manv of the cysts, fistulae, neoplasms, aberrant growths and defects which occur in the head and neck are difficult to interpret unless one can picture rather clearly the complex series of events which has led to the structural arrangements characteristic of the adult. Consider as ex amples the finding of thyroid or parathyroid tissue deep to the sternum, or of thymus tissue high in the neck, the presence of ectopic thyroid fragments and fluid filled cysts along the mid-line of the neck, and the particular sites of exit chosen by branchial fistulae. Such conditions are to be explained as the results of embryo-logic mishaps and failures. In assuming their definitive positions, many of the newly formed embryonic structures travel relatively far from their original sites. But the migrations are not always successfully accomplished structures may wander too far afield or take an unusual route. Occasionally the connection of a struc ture to its point of origin is incompletely erased so that epithelial remnants or rests remain buried at various points along the pathway of migration

Anomalies and neoplasms which stem from such developmental mishaps frequently come to the attention of the clinician He must then combine his skill and ingenuity with a knowl edge of the embryology of the region in order to interpret correctly the situation before him and to plan his surgical procedure In a volume such as this, therefore it seems appropriate to trace briefly those early stages in the de velopment of the head and neck which will render more understandable the clinical and surgical considerations to follow

In this chapter no attempt will be made to discuss the pathology of the regions considered However, correlations will be made where a particular stage of development clearly offers a basis for the explanation of certain abnormal anatomical relationships and pathologic de velopments in the adult Such points will be included in the course of the discussion where this is feasible, or else in a closing paragraph of a section

Many aspects of development will, of ne cessity, have to be treated briefly and some omitted However an effort will be made to emphasize those embryonic structures and sys-tems whose derivatives, through developmental peculiarities, frequently come to the attention of the physician and surgeon It will be suffi cient to review only the events of the first few months of intrauterine life In an embryo of three weeks development a number of structures (or, at least their precursors) which are to be found in the adult head and neck are already in evidence Rudiments of neural, skeletal facial oral, and pharyngeal structures are beginning to appear The precocious de-velopment of the central nervous system of the embryo with the formation of its primary brain divisions is perhaps so well known that it will require no especial discussion However the origin and fusion of the various components of the cranium and face and the detailed structure of the anterior end of the foregut and the formation and fate of the branchial appara tus and its derivatives may not be so readily recalled These regions then will be the ob-jects of particular attention

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THE DEVELOPMENT OF THE AXIAL SKELETON

The Vertebrae

The simplest vetebrates possess an elongated bar of supporting cells, the *notochord* or *chorda* which lies in the midline just beneath the central nervous system In accordance with the biogenetic law the notochord is conspicuous in the very young embryo lying just deep to the ectodermal plate which is to form the neural tube. Thus, a provision for a firm supporting framework for the body is already made by the end of the second week, even before the formation of the mesodermal somites has begun By elongation, the chorda comes to extend from the caudal end of the embryo to the hypophyseal region About this continuous axial rod there later develops the segmented axial skeleton (Fig 19)

The first evidences of segmental arrangement of structures in the body are clumps of mesodermal cells which lie in close relationship to the sides of the neural groove and later, the neural tube. These mesodermal masses are called *somites* In cross-section their cells show a radial arrangement. A central lumen soon appears in the somite, transforming it into a thick walled vesicle Because of the varied potentialities of the cells of the somite, it is described as having three regions. The dorsomedial portion is destined to give rise to the skeletal muscles and is thus called the *myotome* The ventrolateral part of the somite, the *dermatome* contributes some cells to the deeper layers of the skin but probably in larger measure forms muscle. The medial component of the somite is the *sclerotome* the cells of which become less closely packed and drift ventromedially toward the neural tube and the notochord (Fig 20) The sclerotome is of particular interest in the present discussion because of its role in the formation of the axial skeleton.

Each sclerotome of the linear series differentiates into a dense caudal, and a less dense cephalic half Following a separation of dissimilar halves, each fuses with the half adjacent to it in the neighboring sclerotome to begin the formation of a vertebra. The dense part of each fused pair forms a medial *chordal process* a *dorsal* or *neural process* and a ventrolateral projection—the *ventral* or *costal process* Enveloping the notochord as they meet in the midline, each pair of chordal processes forms the *body* of a vertebra The lighter mesenchyme which remains between the bodies of successive

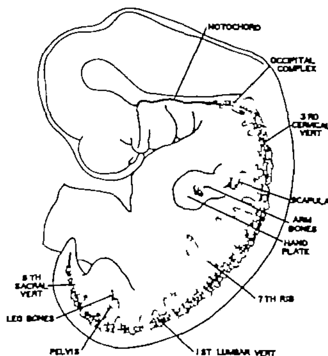


Fig 19 Diagram of a 9 mm. human embryo (about 5½ weeks) to show the craniocaudal extent of the chorda and its relationship to the vertebral and cranial primordia. (After Patten 46, adapted chiefly from the work of Bardeen.)

vertebrae forms the *intervertebral discs* The notochord in the disc proliferates to form the *nucleus pulposus* while the part encompassed by the dense mesenchyme or *scleroblastoma* gradually regresses. Sclerotomal cells also collect about the cephalic part of the chorda to become the *parachordal cartilages* These give rise to the basioccipital and part of the basisphenoid bones. At about the middle of the fifth week the dim outlines of the axial skeleton are cast in mesenchymal condensations (Fig 19) Chondrification begins soon thereafter first in the vertebral centra, then in the neural and costal processes. Lateral extensions of the neural processes and prolongation past the

point of union form the *laminae* and *spinous processes*

The foregoing account is, briefly the plan of origin of all vertebrae Regional modifications occur In the thoracic region the costal processes are prolonged into ribs. In other regions fuses with the proximal part of the first thoracic sclerotome Thus the number of original cervical vertebral primordia becomes reduced by one

The first and second cervical vertebrae show some especial modifications The atlas repre-

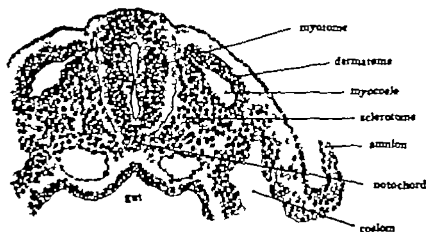
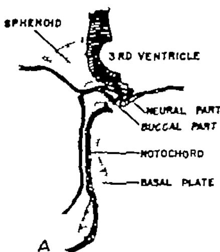
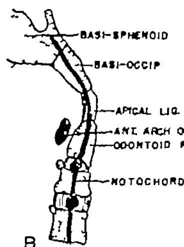


Fig 20. Transverse section of a 16-somite pig embryo showing sclerotomal cells migrating toward the notochord (From Patten 46 courtesy of B M Patten and The Blakiston Co., Phila)





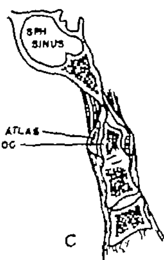


Fig 21

A. Basal plate of skull (seventh week) showing relationships of chorda to skull pharynx and hypophysis. (After Keith, 33)

B Diagram of a section of the fetal axis atlas, basioccipital and basisphenoid to show the relationship of the chorda to bones and ligament (After Keith, 33)

C Diagram of a similar section in the adult (Modified from Grant 48 Courtesy Williams & Wilkins Co Balto.)

the costal processes remain rudimentary fusing in the cervical region with the transverse processes to encircle the vertebral artery The seven cervical vertebrae arise from the original eight cervical sclerotomes. The cephalic portion of the first cervical sclerotome becomes incorporated with the occipital sclerotome lying above it while the caudal part of the eighth

sents the completed bow of the first cervical vertebra, the body of which has left it to become fused to the next lower vertebra the axis. On the axis the body of the atlas is seen in the form of the *odontoid process* Sometimes a splitting of the odontoid process will reveal the remains of the original disc between the first and second vertebrae The *apical ligament of*

the dens (suspensory lig) which in the adult, runs from the axis to the basioccipital, represents the disc which existed between the last occipital segment and the atlas (Figs 21, and 43)

The Skull

Parts of the skull are phylogenetically more ancient than others. The brain of higher vertebrates overflows the bounds of its original cranial basin, accordingly, additions are made in the form of lateral walls and a roof Changes in environment and mode of life, made possible by emancipation from an aquatic life, necessitated certain modifications in the jaws and breathing apparatus. These changes were chiefly responsible for the erection of a facial scaffolding for the support of the teeth and a bony partition for the separation of nasal and oral cavities The face, therefore, is also new, although certain elements of the modified branchial apparatus contribute to its construction.

While the older portions of the brain case develop in a cartilaginous blastema like the rest of the axial skeleton, its newer acquisitions omit the chondral stage of development, they arise directly from a dense mesenchmyal membrane. Thus, the brain case consists of the older *chondrocranium* and the newer *membranous cranium* The facial skeleton, too, is developed in membrane although it contains branchial elements which develop cartilage like the other more ancient parts of the head skeleton

The portions of the skull which collectively, form an investment for the brain and sense organs are generally referred to as the *neurocranium* Suspended below and ventral to the neurocranium is the facial skeleton Since the latter mainly subserves visceral functions it is termed the *splanchnocranium*

THE NEUROCRANIUM

Chondral portions (Chondrocranium) As shown earlier the notochord extends cephalically as far as the hypophyseal region. A part of the old cranial floor the occipital plate develops about this portion of the notochord The first signs of its formation are seen during the fifth week of development when sclerotomal cells begin to migrate cephalically from the head segments as far as the end of the notochord The *parachordal* masses which result converge upon the notochord, but fail to envelop it completely It is left exposed on the cerebral surface of the basioccipital bar and ventrally on its pharyngeal surface. Farther rostrally the notochord runs between the basioccipital and sphenoidal rudiments to the base of the dorsum sellae (Fig 21, A and B) The scleroblastema fused about the chorda forms the *occipital plate* (also termed the chordal plate because of its association with the notochord) A further cephalic extension of scleroblastic mesenchyme forms the *prechordal* region of the skull base with a sphenoidal region adjoining the occipital plate and, more cephalad, an ethmoidal area. The prechordal region corresponds to the bilateral cranial trabeculae of lower vertebrates. The buccal part of the hypophysis enters the cranial cavity just cephalad to the end of the notochord and spreads the sphenoidal portion of the trabeculae apart. Caudally they fuse to the basal plate and rostrally they unite to form the basis of the nasal septum of the ethmoid (Fig 22 A) The scleroblastic shelf for the brain is completed by a further condensation of mesenchyme forming the otic capsule. This forms the petromastoidal portion of the temporal bone which becomes wedged between, and fused to the chordal and prechordal plates.

Meckel's and Reichert's cartilages, derived from the first two visceral arches, are closely related at their proximal extremities to the otic capsule and make certain contributions to the formation of the chondrocranium These structures and their relationships to the otic region will be considered to better advantage in the section dealing with the branchial apparatus.

The entire skull base becomes chondrified into a continuous unit (Fig 22 B) At this stage (eighth week) the individual bones can not be made out except by their general outlines Ossification centers, when they begin to

appear and spread indicate the areas to be occupied by the individual bones.

Membranous portion. The mesenchymal sheet covering the sides and upper surface of the brain undergoes a process of lamination from which three layers result. The outermost layer just under the ectoderm gives rise to the dermis, the inner one closest to the brain pterygoid process also develops in membrane. Beginning from one or more centers in the membranous capsule of the brain bony fibers spread out as a thin sheet. This bony layer divides the intermediate of the three layers mentioned above into an outer layer, the pericranium, and a deep one, the periosteal layer of dura mater. The two layers are continuous

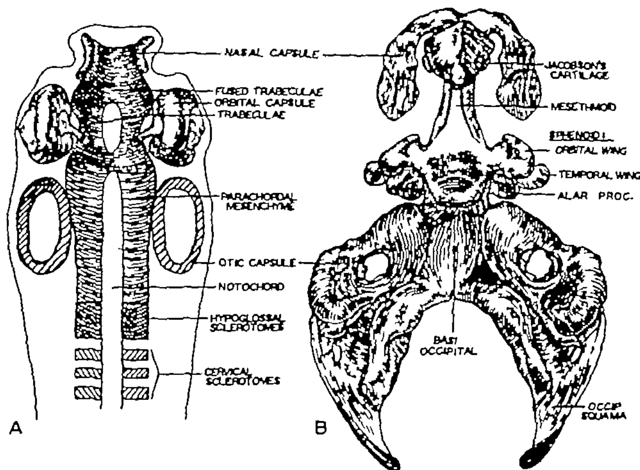


Fig. 22

A. *Schema showing relationships of para- and prechordal mesenchyme to the notochord, the otic, optic and nasal capsules, and the hypophysis.* (Modified from Corning, '21.)

B. Skull base of a human embryo (about 8 weeks) viewed from above. (Adapted from Lewis, '20. Courtesy W. H. Lewis and Carnegie Inst. of Washington.)

forms its meninges. It is in the intermediate layer that the membrane bones of the calvarium develop.

In the eighth week centers of ossification begin to appear in the areas of the walls and roof of the cranium. Centers develop for the frontal, parietal, interparietal portion of the occipital, squamous portion of the temporal and its zygomatic process and the orbitotemporal part of the greater wing of the sphenoid. Beneath the sphenoid its medial over the margins of the bony plates. For a time after growth of the various centers has carried their margins to the suture lines, parts of the membranous capsule remain unossified. These areas are the familiar *fontanelles* of the infant skull.

THE SPLANCHNOCRANIUM

The facial skeleton, as stated above, is one of the newer additions to the skull and as such develops almost entirely in membrane

The facial bones include the maxilla, palatine bone zygoma vomer, inferior nasal concha, lacrimal and nasal bones, and the mandible. reach the zygomatic process of the temporal bone (also membranous) The vomer, palatine, lacrimal and nasal bones arise from mem

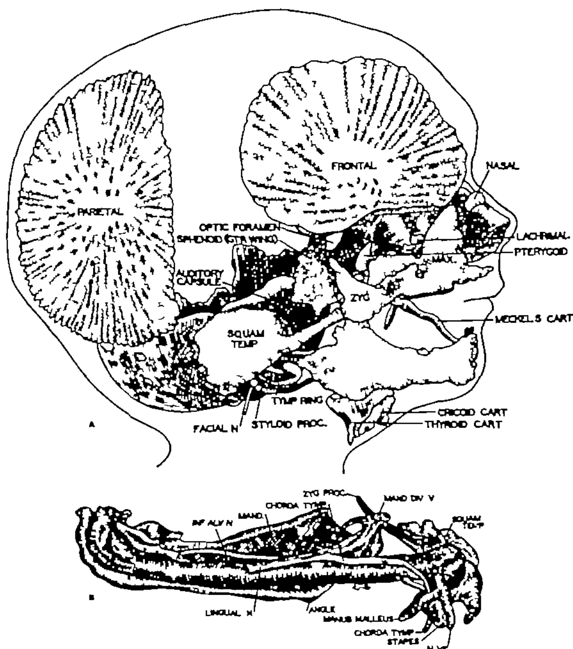


Fig 23

A. Partially ossified membrane bones (stippled) of the skull of an 80 mm (12 weeks) fetus, shown in relation to the chondral portions (line shaded) (After Gaup '06)

B Medial view of the mandible at about the ninth week (43 mm) showing the relationship of membrane bone to Meckel's cartilage Note middle ear ossicles of visceral arch origin and positions of parts of the cranial nerves V and VII (After Macklin, '21 Courtesy C. C. Macklin and Carnegie Institution of Washington.)

A center of ossification appears in the maxillary process of the first visceral arch [1] The zygoma develops in membrane on the lateral aspect of the face below the eye and grows backward to brane in the vicinity of the nasal capsule. These bones partially ossified, are shown in relation to the chondral portion of the skull in Fig 23 A. The inferior nasal conchae, al though counted among the facial bones, do not share their membranous origin they ossify from centers in a medial projection of the

[1] There is some evidence from comparative anatomy that a portion of the maxilla may develop in cartilage (See section on branchial arch derivatives)

cartilaginous nasal capsule The mandible will be discussed in greater detail in the section dealing with the branchial arches However it should be pointed out here that Meckel's cartilage of the first branchial arch serves only as a temporary scaffolding and contributes none of its substance in the construction of the mandible In the body of the developing mandible, membranous bone encloses the car-

TABLE 2

The Chondral and Membranous Portions of the Neurocranium

Bone	Parts of chondral origin	Parts of membranous origin
Occipital	Basioccipital Exoccipital Supraoccipital (below superior nuchal line)	Interparietal
Sphenoid	Body Presphenoid Basisphenoid Lesser wings (orbitosphenoid) Greater wings (alisphenoid except tips) Lingulae	Medial pterygoid Lamina (except hamulus) Greater wings (orbito-temporal portion)
Ethmoid	All	—
Temporal	Petromastoid area Styloid process (2d arch)	Squamous Zygomatic Tympanic ring
Middle ear ossicles	Malleus (1st arch) Incus (palato-quadrate) Stapes (2d arch)	
Frontal	—	All
Parietal	—	All

tilage along with the inferior alveolar nerve (Fig 23 B) The ramus ascends lateral to these structures and the foramen on its medial surface marks the most dorsal extent of their enclosure. The enclosed part of the cartilage, as a rule, disappears completely

From the foregoing, it may be seen that in a general way the more ancient parts of the skull pass through a cartilaginous stage in their development while the parts more recently added omit this stage, arising directly from membrane However it should not be assumed that these principles hold true categorically, for chondral and membranous parts become intermingled to some extent during development Examples of such fusion are to be seen in the occipital bone (basal plate) whose squamous portion above the superior nuchal line (interparietal) is of membranous origin and in the sphenoid (prechordal) of which the terminal orbitosphenoid portion of the greater wings and the medial pterygoid laminae are developed in membrane. For the sake of convenience and brevity the bones of the neurocranium are listed according to their mode of origin in the accompanying table (Table 2) (As mentioned previously the facial bones with the exception of the inferior nasal conchae and perhaps a portion of the maxillae are all formed in membrane)

A knowledge of the parts of the skull according to their mode of development is of more than academic interest for it is certain

that chondral and membranous portions do not show an equal predilection to certain diseases of bone Chondromas, for example, appear to occur only in areas of the skull which have a cartilaginous origin, while membrane bone is seldom the site of a chondrosarcoma.

The Fate of the Notochord

The notochord a prominent structure of the early embryo, begins to degenerate and disappear during the second month of development While the notochord becomes quite obscure in the adult it is still represented in certain parts of the axial skeleton The role of the notochord in forming the mucoid core of the vertebral discs and its disappearance in the centra have been mentioned The bridge between the basiocciput and the body of the atlas (odontoid process of the axis) is the apical or suspensory ligament of the axis. It is a vestige of the disc between the atlas and the basioccipital bone Accordingly, it contains a notochordal remnant (Fig 21 B) A nodule occurring in the apical ligament may represent an occipital centrum. As shown in Fig 21 A and B and Fig 25 B the extra vertebral portion of the chorda is located within the bony substance of the basioccipital and basisphenoid, except for an intermediate portion which becomes closely related to the pharyngeal epithelium According to Macklin (1921), the embryonic notochord shows localized enlargements and is especially contorted and varicose where it makes contact with the pharyngeal bursa. Its terminal portion within the basisphenoid is broader than elsewhere and its end is somewhat nodular

Remnants of the notochord associated with the skull base sometimes give rise to malignant growths termed chordomas There appears to be some correlation between the positions of the embryonic enlargements of the chorda and the sites at which chordomas most frequently occur These growths may appear anywhere along the cranial portion of the notochord, but occur most often where the notochord is near the surface as in the clivus, pituitary fossa, at the odontoid process or in the pharynx In the last mentioned location, especially, where a notochordal remnant may be left in intimate contact with the pharyngeal epithelium conditions appear to be particularly favorable for rapid cellular proliferation For additional material on the origin of chordomas and numerous references to specific cases, see Stupka (1938 pp 265 and 306)

THE EARLY DEVELOPMENT OF THE FOREGUT

The Formation of an Oral Cavity

At the time when somites are first beginning to form in the embryo (around the sixteenth day) the primitive alimentary tract or gut has not yet attained its tubular form, but opens widely into the yolk sac. After the proliferation of the mesoderm and the association of its splanchnic portion with the entodermal lining of the gut, body folds delimit the margins of the embryo Rapid cranial, caudal, and lateral growth of the embryo makes the folds appear to push in beneath the embryo, undercutting it and tending to pinch it off from the extra embryonic structures. The process of pinching off is incomplete, however, and the embryo remains attached to the extra-embryonic membranes by a stalk entering the ventral wall at the site of the future umbilicus (Fig 24)

The rapid cephalic and caudal extension of the embryo results in prolongations of the gut cavity into the head and tail regions and establishes the digestive canal. This primitive digestive tract is, in fact, tubular cranially and caudally but is incomplete in its intermediate portion or *midgut* where it is still in open communication with the cavity of the yolk sac (Fig 24 A) At this stage, the terminal extensions of the gut, with their entodermal linings, are blind recesses, so that neither end of the alimentary canal is open to the outside The cephalic portion is termed the *foregut*, the caudal, the *hindgut* At first the surface of the embryo shows no sign of the cephalic and caudal openings of the digestive tract Then, around the eighteenth day the body ectoderm over the blind ends of the fore- and hindgut sinks in toward the tips of the canal. The

cephalic depression over the site of the future mouth is termed the *stomodaeum* It deepens until its ectodermal floor is pressed against the entodermal lining of the foregut The resulting membrane is the *oral* or *stomodaeal* plate (buccopharyngeal membrane) (See Fig 24 A.) Toward the end of the fourth week the membrane ruptures, so that the formerly blind foregut is now in open communication with the embryo's outside world—the amniotic cavity (Fig 24 B and Fig 25 A) There occurs a further deepening of the stomodaeum as a result of the growth of structures immediately surrounding it, and this enlarged and deepened opening later becomes the oral cavity The area of transition from mouth to pharynx in the adult (the tonsillar region) corresponds closely to the position of the marginal attachments of the oral plate which originally delimited the stomodaeal depression from the pharyngeal portion of the foregut

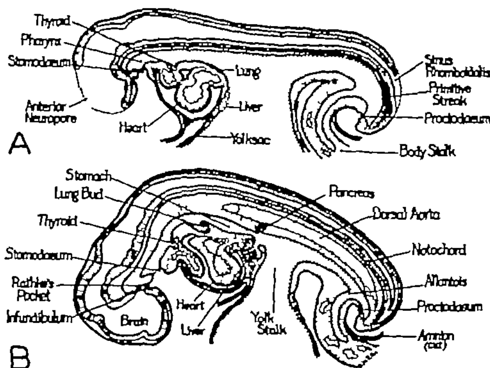


Fig. 24 Sagittal sections (semi-diagrammatic) of human embryos showing stages in the development of the digestive system.

A. Age about 22 days the ends of fore- and hindgut are closed by ecto-entodermal membranes.

B Toward end of fourth week rupture of the oral plate establishes continuity between stomodaeum and pharynx. In both A and B the notochord is shown as a solid line beneath the neural tube (From Patten 46. Courtesy B M Patten and the Blakiston Co., Phila.)

The Hypophysis

At this early stage the most significant structure which develops from the stomodaeum is an ectodermal outgrowth from its roof called *Rathke's pocket* Just prior to the rupture of the *oral plate* Rathke's pocket appears immediately external to it and extends brainward toward the *infundibular process* of the diencephalon (Fig 24 B and Fig 25 A and B) Rathke's pocket is the primordium of the anterior lobe the infundibulum represents that of the posterior lobe of the hypophysis. The deeper portion of Rathke's pocket for a time remains connected to its point of origin by an elongated stalk which is lodged in the *craniopharyngeal canal* (Fig 25 C)

Practical Considerations

Of practical importance is the fact that the ectodermal stalk extending from the stomodaeum to the hypophysis is not always completely obliterated Consequently there is a opportunity for the appear masses of anterior lobe tissu anywhere along the line c nection between the stom terior lobe in the sella turc and in the sphenoid bone

frequently amongst the soft tissues of the dorsal wall of the pharynx Indeed the *pharyngeal hypophysis* is so frequently present that many authors (Civalleri, 1909 Christeller 1914 Melchionna and Moore, 1938, and others) consider it to be a normal growth

colloid filled cysts may appear near the anterior lobe of the hypophysis or in the pharyngeal hypophysis (Stupka, 1938, p 267)

The stalk of Rathke's pocket establishes a tunnel, the craniopharyngeal canal, which is normally obliterated by the end of the second

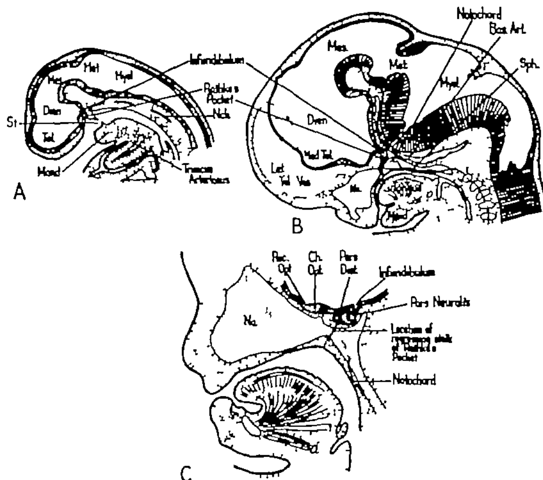


Fig 25 Diagrams of human embryos showing the dual origin of the hypophysis from Rathke's pocket and the infundibulum

A. At 4 weeks. (Note Rathke's pocket just rostral to oral plate, infundibulum and notochord)

B At 6½ weeks. With development of face and oral structures, origin of Rathke's pocket is relatively deeper than in A (Note relationship of notochord to hypophyseal, vertebral and cranial primordia.)

C At the eighth week Stomodaeal and neural elements of hypophysis are united in sella turcica. (Note stalk of Rathke's pouch is becoming obliterated in craniopharyngeal canal.) (From Patten 46. Courtesy B M Patten and the Blakiston Co Phila.)

Under distinctly abnormal circumstances, the entire pituitary may appear in the nasopharynx Keith (1933) cites a case of median hare lip in which the palate was partially cleft and the hypophysis formed a tumor like mass within the nasal septum

The so-called Erdheim tumors appear in any of the sites just mentioned (Bock 1924) Squamous cell carcinomas are said to arise from the pharyngeal hypophysis (Menzel, 1933) Cysts lined with ciliated epithelium occur along the course taken by the ectodermal pocket, and

fetal month or soon thereafter (see Froriep 1882, Kulischer, 1904) This canal is said to persist in 10 percent of fetuses and neonati (Landzert, 1868) but only in 0.3 percent of adults (Sokowlow, 1904, see also Schultz, 1919) Arey (1949) has re interpreted this structure on the basis of its development and feels that there is no direct relationship between the persistent canal and the pathway of Rathke's pocket. However, it is of practical importance to note that in cases of open craniopharyngeal canal cysts of the anterior lobe

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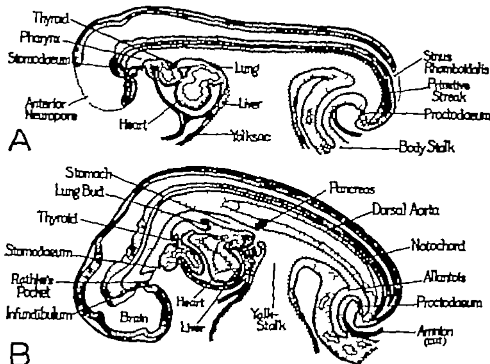


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Practical Considerations

Of practical importance is the fact that the ectodermal stalk extending from the stomodaeum to the hypophysis is not always completely obliterated Consequently there is an opportunity for the appearance of ectopic masses of anterior lobe tissue. These may occur anywhere along the line of the original connection between the stomodaeum and the anterior lobe, in the sella turcica of the sphenoid and in the sphenoid bone itself but most

frequently amongst the soft tissues of the dorsal wall of the pharynx Indeed, the *pharyngeal hypophysis* is so frequently present that many authors (Civalleri, 1909, Christeller 1914, Melchionna and Moore, 1938, and others) consider it to be a normal growth.

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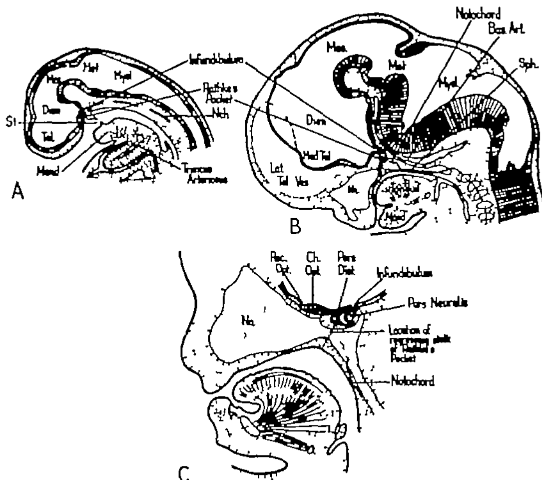


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of the hypophysis or its original stalk can extend into the pharynx (Neumann 1932) and a pituitary completely filling the canal has been described (Haberfeld 1910) For further references to works on cysts and tumors of the hypophyseal primordia and persistent craniopharyngeal canal (see Stupka 1938 pp 306–307)

THE EYE

The eye is a compound structure deriving its optic nerve and retina from the forebrain (neural ectoderm), its lens from the overlying ectoderm and its outer coats and accommodating mechanism from the surrounding mesenchyme.

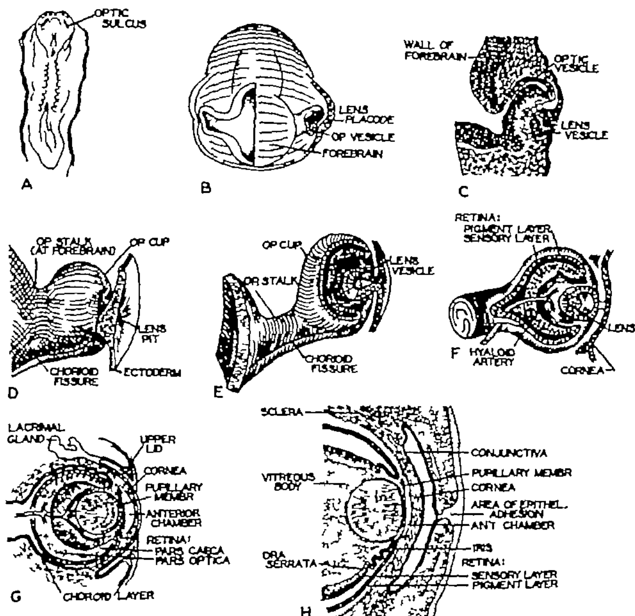


Fig 26. Early development of the eye. (Adapted from various sources, chiefly Ida Mann, 1928, and C. L. Davis 1947)

A. Dorsal view of a 9-somite embryo showing optic region of the forebrain.
B Cephalic view of the forebrain of a 20-somite embryo (about 23 days)
C. Section through the optic cup and lens pit of a 5 mm. embryo (about 4 weeks)
D Sketch showing the invagination of the optic cup, deepening of the lens pit and the choroid fissure. (Human embryo of 5.5 mm. early fifth week.)
E. Optic cup and stalk in a 7.5 mm. (5 weeks) embryo. Lens and optic cup have been partially cut away
F Diagram of the eye of an embryo of 12 mm. (6 weeks).
G. Diagram of the eye of an embryo of 26 mm. (In the eighth week)
H. Drawing of a section through the anterior portion of the eye in an embryo of 48 mm. (In the tenth week)

While the neural plate is still open anteriorly and posteriorly, *optic sulci* appear in the region which is to become the forebrain (Fig 26 A) These grooves deepen into optic vesicles (Fig 26 B) and by the fourth week the connections of the latter to the brain have constricted to form the *optic stalks* (Fig 26 B) By the fifth week the optic vesicle has become flattened It then becomes deeply indented to form a double-layered optic cup (Fig 26 C) whose two walls give rise to paired retinal layers, the inner one thickens to become the sensory or visual layer, while the outer remains relatively thin, acquires melanin granules, and becomes the pigment layer of the retina.

The invagination which occurs in the optic vesicle does not produce a perfect cup, for at one point the indentation cuts through both layers of the cup and extends brainward along the optic stalk The cleft thus formed in the cup and its stalk is termed the *chorioid fissure*. In the seventh week of development the edges of the chorioid fissure meet and fuse, establishing a symmetrical cup and a tubular stalk which is, in reality, a tube within a tube. The tunnel, thus formed, serves as a conduit for both optic nerve fibers as they grow toward the brain and for the *hyaloid artery* as it extends into the eyeball

The Lens

During the early stages in the formation of the optic cup, a thickening of the ectoderm overlying the optic cup (*lens placode*) invaginates and then pinches off to form the *lens vesicle* (Fig 26 B to E) This vesicle loses its connection with the superficial ectoderm and comes to rest within the opening of the optic cup (Fig 26 C D E, and F) The outer and inner walls of the lens are of unequal thickness, the outer becoming reduced to a thin layer known as the *lens epithelium* (Fig 26 F G) The cells of the deeper wall elongate to form the *lens fibers* With their growth the space within the lens is reduced to a potential slit. Cells located equatorially about the lens give rise to new lens fibers which extend toward the poles (Fig 26 G H) These fibers are continually added to the original core until the age of twenty years. With a further deepening of the optic cup, the lens comes to lie almost completely within it. There occurs a relative narrowing of the aperture of the cup so that its free edge overlaps the lens somewhat The lip of the cup becomes markedly thinner and permits a division of the retina into a larger visual portion and the marginal blind portion The irregular junctional zone between these parts is termed the *ora serrata* The cup's rim becomes the *iris*, while its mouth represents the aperture known as the *pupil* (Fig 26 H)

The Iris and Ciliary Apparatus

Adjacent to the ora serrata, the double-walled retina is further subdivided into a folded ciliary portion, and the terminal part, above referred to, which is the iridic portion (Fig 26 H) Pigment present at first only in the outer of the two epithelial layers is later acquired by this portion of the inner layer as well. Extension of the iridic epithelium gives rise to the epithelial portion of the iris. According to Mann (1928), its outer layer proliferates unpigmented cells, which bud off and differentiate into the radial and circular muscles of the iris Loose mesenchymal cells adjacent to the folded, ciliary portion of the retina differentiate into the ciliary muscle which, through its attachment to the suspensory ligament, later controls the shape of the lens.

The Tunics of the Eyeball

From the beginning the optic vesicle is surrounded by the mesenchyme which envelops the brain Through condensation and delamination, this mesenchyme supplies an outer fibrous layer, the *sclera*, and an inner vascular and pigmented layer which becomes the *chorioid coat* of the eyeball After the lens has lost its contact with the surface ectoderm mesenchyme extends into the resulting space. The ectoderm, together with the subjacent mesenchyme, forms the *cornea* of the eye (Fig 26 G) In front, the sclera is continuous with the cornea while proximally it continues into the

sheath of the optic nerve and, through it into the dura mater

The Chambers of the Eye

A space develops in the mesenchyme which lies between the cornea and the lens and filling with fluid, this space becomes the anterior chamber of the eye A fine mesenchymal layer remains for a time in front of the lens and lying superficial to the iris, extends across the opening of the latter This layer is termed the *pupillary membrane, a structure which usually* disappears shortly before birth (Fig 26 G H) The space between the lens and iris fills with fluid to form the posterior chamber With the breakdown of the pupillary membrane, the *anterior and posterior chambers become confluent.*

In the larger space between the deep surface of the lens and the lining of the optic cup there is produced a reticulated jelly like substance *the vitreous humor* Whether the fibers of this hyaloid substance are of ectodermal or mesodermal origin is not known with absolute certainty Mesenchymal cells do enter the optic cup through the choroid fissure and around the lens, but these are probably chiefly involved in the production of vascular structures within the eye The *hyaloid artery* which enters the eye through the choroid fissure and runs forward toward the lens, is surrounded by the vitreous body and occupies a canal in its substance. This artery later disappears, its proximal portion remaining as the central artery of the retina.

The Retina

While the outer pigmented layer of the retina remains quite thin the inner optic portion becomes *thickened and* is a region of rapid cellular proliferation The visual portion of the retina has first an outer cellular layer and an inner fibrous layer From the cellular layer cells pass to a deeper level and become the *multipolar cells* of the *ganglion cell layer* Other cells separate from the cellular layer to form the layer of *rod and cone cells* There then exists an inner ganglionic layer an *outer stratum* of rod and cone cells, and an intermediate layer whose cell processes connect the cells of the other two In addition supporting cells form in the retina (fibers of Müller) whose processes extend from internal to external limiting membranes.

In the third month the axons of the ganglion cells are seen converging toward the optic stalk. These axons enter and traverse the stalk via the closed choroid fissure, undergo partial decussation at the optic chiasma, and course brainward to terminate in the metathalamus.

Accessory Structures

Eyelids. In the seventh week, ectodermal folds containing mesenchyme project above *and below the eye (Fig. 26 G) Through* rapid growth they meet and fuse early in the third month. This fusion persists until about the middle of the seventh month. While fused, the epithelium of the margin of the lids gives rise *to numerous small sebaceous glands and to the* follicles of the eyelashes. The epithelium of the outer surface of the lids is similar to that in other areas where the skin is thin, but having rounded the margin of the lid, the epithelium becomes stratified columnar and as the conjunctival epithelium, lines the inner surface of the lid It is reflected onto the anterior portion *of the sclera and is continuous with the trans*parent corneal epithelium

Lacrimal gland. The lacrimal gland arises in the ninth week in the form of a group of solid epithelial buds, from six to twelve in *number These buds branch become canalized,* and merge to form a glandular mass situated at the upper and outer part of the conjunctival sac.

Practical Considerations

A structure with a developmental history as complex as that of the eye may be expected to show numerous *defects. Some of the more* common anomalies of developmental origin are conditions such as coloboma persistent pupillary membrane congenital cataracts, redundancies of the retina and persistent hyaloid *artery to mention* a few More severe but for

tunately far less frequent, are the conditions of anophthalmia, cyclopia, cases of multiple eyes, and congenital cystic eye

More important in the present discussion are those maldevelopments of the eye which are of particular concern to the surgeon

Orbital cysts. These arise as protrusions of the wall of the eyeball along the course of the choroid fissure. Such a cyst apparently marks the site of a weakened area where the edges of the fissure have improperly fused The cyst carries representatives of both fibrous and neural layers of the eye The eye itself, may be normal, but is more often microphthalmic and may show other abnormalities related to improper closure of the choroid fissure, such as coloboma of the iris, ciliary body choroid, or retina.

Glioma (neuroblastoma) retinae. This type of retinal tumor is probably to be explained upon the basis of the persistence of non-differentiated cells of the inner layer of the optic cup Retaining their vegetative potentialities, these cells divide rapidly to produce a highly malignant growth

Congenital corneal tumors. Such tumors or dermoids ' consist of both mesoblastic and ectodermal tissues They vary in severity and may take the form of a small fibro-fatty tumor at the corneal margin or replace the entire cornea by fibro-fatty tissue. In the most severe cases the dermoid extends from the epithelium of the iris to the ectoderm, replacing all the normal tissues of this interval and eradicating the anterior chamber Since these growths are covered by ectoderm, they frequently bear hairs and other skin derivatives. More deeply they may consist of fat and fibrovascular tissue.

Dermoid cysts. These may appear above the eye at the outer or inner angle. They are hollow cysts having walls of connective tissue with ectodermal linings. Their mode of origin is not known with certainty but they may represent ectodermal inclusions along the lines of embryonic healing' or bits of ectoderm snared off by adhesions formed between the skin and dura prior to the time when the skull bones come to intervene between them

Cystic protrusions of the dura (meningocoeles) are sometimes seen at the upper inner angle of the orbit These probably represent dural tissue which has escaped from the skull through imperfect closure of cranial sutures (ex between ethmoid and frontal bones)

Abnormalities of the lacrimal apparatus. Congenital anomalies of the lacrimal gland are rare, but it may be absent or become cystic. The lacrimal passages, since they are first developed from buried strands of epithelium and are later canalized, may be blocked through failure of canalization or the canaliculi may fail to connect with the *puncta lacrimalia* Fistulae of the lacrimal sac probably result from the canalization of epithelial connections between the sac and the surface.

For the embryological basis of many other serious anomalies of the eye, the reader should consult the excellent work on 'Developmental Abnormalities of the Eye by Ida Mann

THE FACE, ORAL AND NASAL CAVITIES

THE FORMATION OF THE UPPER LIP

The rounded frontal end of the head overhangs the stomodaeum and thus forms the cephalic boundary of the oral pit It is called the *frontonasal* or more simply, the *frontal process* (Fig 27 A and B) The process remains undivided above and becomes the forehead In the fourth week of development the *nasal placodes* appear near the margins of the frontal process and slightly cranial to the lateral ends of the stomodaeal opening (Fig 27 A) The placodes soon (in the fifth week) deepen into *nasal pits* the arching margins of which project downward toward the upper lip of the oral opening In so doing the medial projection from the nasal pit, the *nasomedial process* interrupts the lower margin of the frontal process, dividing it into three parts. There results a median portion consisting of a pair of *nasomedial* (globular) *processes* with a portion of the frontal process between them To either side of the nasal pits are their lateral

projections, the *nasolateral processes* (Fig 27 C) At this stage then the cephalic border of the oral cavity comprises the medially placed frontal and nasomedial processes, and laterally, the maxillary processes. These structures are destined to form the upper lip, upper jaw, and the nose.

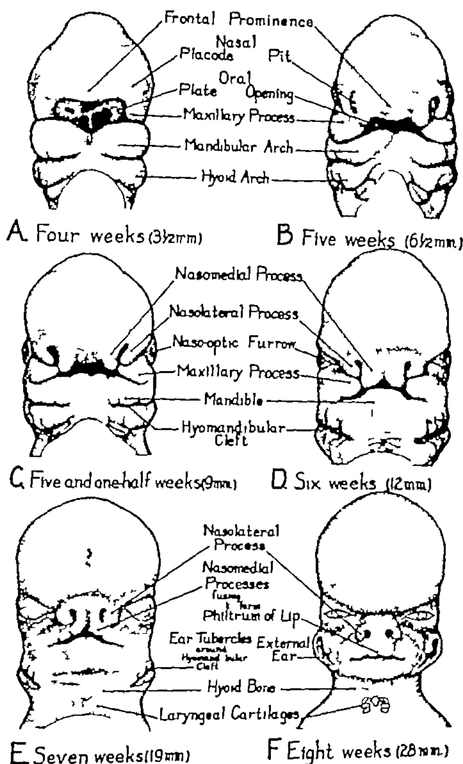


Fig 27 Frontal views of human embryos illustrating the development of facial structures (After W Patten from Morris "Human Anatomy" Courtesy B M Patten and the Blakiston Co Phila)

From the dorsal part of the mandibular arch the maxillary processes gradually extend forward from the angles of the mouth pass

below the nasolateral processes, and extend medially to touch the rapidly growing nasomedial processes (Fig 27 B and C) The advancing maxillary process drives ahead of it the nasomedial process of that side and fuses with it, the nasomedial processes now crowded to the midline, in turn fuse with one another (Fig 27 C, D and E) According to Frazer (1932) and Boyd (1933), the medial extensions of the maxillary processes take a superficial position so that the lower end of the frontal process forms only the deeper portion of the medial part of the upper lip Others (His, 1885 Keith, 1933), maintain that the entire central portion of the lip derives from the lower end of the frontal process. Depending upon the viewpoint accepted the *philtrum* of the upper lip is either the result of the heaping up of maxillary mesoderm on either side of the midline, or the fusion of the two nasomedial processes. The results of these growths and fusions are the complete isolation of the nasal pits from the oral pit, and the establishment of a continuous ledge which forms the upper lip The maxillary processes form the upper part of the cheeks and by fusion with the nasomedial processes, the upper lip (Fig 27 F)

The optic vesicle which meanwhile, has been developing in a position slightly dorsal to the nasal pit, becomes lodged in the angle formed by the convergence of the maxillary and nasolateral processes. The groove between the processes thus runs from the inner corner of the eye to the nasal pit and is termed the *naso-optic* (nasolacrimal) *furrow* This furrow marks the line of fusion of the maxillary and nasolateral processes and it is usually held that it is along this line that the ectodermal tract, destined to become the nasolacrimal duct, is buried. At least one report, however (Politzer 1936) states that the duct is an independent epithelial downgrowth from the conjunctival sac, which merely uses the naso-optic furrow as its guide In any case, the important point here is that congenital atresias of the nasal end of the duct occur Imperfect tunneling of the duct or persistence of what might well be called a lacrimo-nasal membrane not infrequently constitute barriers to the normal flow of tears (Schaeffer, 1948)

The Lower Lip and Jaw

The lower margin of the oral cavity consists of only one element. It is the mandibular or first arch of the branchial apparatus. This arch gives rise to the lower parts of the cheeks (the upper parts being supplied by the maxillary process), and the lower lip The mandibular arch and its derivatives will be considered in greater detail in the section which deals with the development of the visceral arches.

The Upper Jaw

By the eighth week of intrauterine life some of the bony framework of the face has begun to appear The maxilla, one of the first bones of the body to ossify, develops in the fused maxillary and nasomedial processes. Premaxillary bones form in the fused nasomedial processes The premaxillary element bearing the incisive teeth is usually fused to the maxilla in adult man but still may be distinguished as a separate component in the infant skull and occasionally in the adult. At the point where premaxillary and maxillary elements converge in the midline of the hard palate, a hiatus remains. This is the location of the incisive foramen In many of the lower mammals, open nasopalatine ducts occupy the foramen, but in man only the upper ends of the ducts remain patent, below they end blindly in the incisive papilla The remainder of the maxilla which bears all the teeth behind the upper incisors develops in the maxillary processes.

The Nose

Of the nose, the lateral parts, including the alae arise from the nasolateral processes the medial portion including the cartilaginous part of the nasal septum, is derived from the fused nasomedial processes. The bridge of the nose is produced by the frontal process The isolated openings of the nasal pits become the external *nares* or nostrils (Fig 27 C D E and F)

The Cheeks

As above noted, the cheeks consist of both maxillary and mandibular components. Since the maxilla is a forward growth from the dorsal end of the mandibular arch, the angle formed between them represents the lateral angles of the oral opening A gradual lateral to medial fusion of the maxillary process and the mandibular arch results *in a narrowing of* the originally broad oral aperture. This narrowing is *the chief factor in the production of* the cheeks.

The Establishment of Separate Nasal and Oral Cavities

At first, blind and separated from the oral pit cavity by thin *bucconasal membranes* the nasal pits later (in the sixth week) communicate openly with the mouth to form a common oro-nasal cavity (Fig 28 A) The primitive nasal cavities begin to deepen by upward and backward excavations groove out the roof of the main oral cavity and leave between them a median nasal septum (Fig 28 B) In the lower ventral portion of the septum, where medial and lateral nasal processes have fused the latter give rise to the paraseptal cartilages (Fig 28 C and D) These are associated with an isolated area of olfactory epithelium just above the nasopalatine canal. This area becomes invaginated to form a pocket known as the vomeronasal organ (Jacobson s organ)

Subsequently (eighth week), a shelf the *palatine process* begins to project inwards from the laterally placed maxilla. The advance of the palatine ledges is blocked for a time by the intervention of the tongue so that they are deflected caudally With the subsequent dropping of the floor of the mouth and flattening of the tongue, the palatine processes are free to swing up into the horizontal position and to fuse in the midline (Fig 28 C and D) Bone, contributed by both premaxillary and maxillary elements, develops in this fused shelf to form the hard palate, but is lacking dorsally in the region which is to become the soft palate In the tenth week when the median fusion of palatine processes is accomplished these processes also fuse with the free margin of the nasal septum (Fig 28 D) Thus, the original oral pit cavity is first subdivided into lower (oral) and upper (nasal) compartments, and the latter into lateral halves.

Practical Considerations

By virtue of the many foldings, migrations and fusions which are involved in molding the face and the nasal and oral cavities, there are numerous opportunities for developmental mishaps, any one of which might lead to a serious defect in the surface of the face or its associated cavities. As is well known a variety of such accidents do occur and only a few conditions such as single or double harelip and cleft palate, need be mentioned here as examples.

Not infrequently, at the time when the various clefts are closing during the formation of the face bits of ectoderm become buried as inclusions within mesodermal elements. These dormant epithelial cells, enclosed along lines of fusion may on occasion give rise to one of a variety of dermoid cysts which may contain hair follicles, sweat glands, teeth, et cetera For numerous references to cases, see Thoma, (1944)

Classifications of the various types of cysts in and about the face vary somewhat in terminology However the point of practical importance is that a knowledge of the embryology of the face permits one to specify rather accurately the positions in which cysts arising from epithelial rests are most likely to occur As examples may be mentioned median cysts along the lines of fusion of the halves of the mandible or between the maxillae, in the alveolar bone between the upper lateral incisor and canine teeth and at the position of the incisive foramen—either at the oral opening or filling the entire incisive canal

The vomeronasal organ (Jacobson s organ) usually degenerates completely between birth and the end of the first year but it may persist

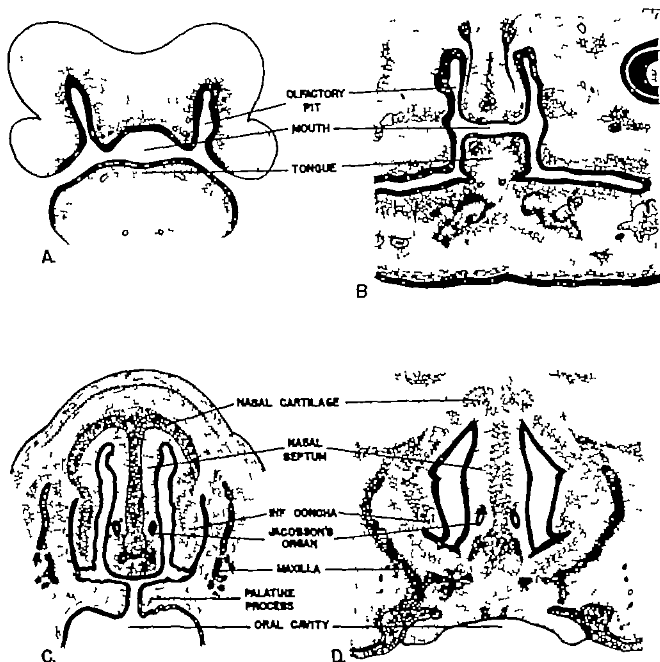


Fig 28. Frontal sections through the heads of human embryos showing the steps in the separation of oral and nasal cavities.

A. At 6 weeks. The primitive nasal cavities have tunneled the naso-frontal region and have perforated into the oral cavity to form a common oro-nasal cavity (Adapted from Davis, 47 Courtesy C. L. Davis.)

B Embryo of about 7 weeks. Formation of the nasal septum has begun palatine processes are deflected by the tongue.

C. Embryo of about 9 weeks. Palatine processes nearly touch in the midline but have fused neither with each other nor with the septum (Note Jacobson s organs and the paraseptal cartilages just below them)

D Embryo of about 10 weeks. The palatine processes have fused with each other and with the nasal septum. (B C and D adapted from Corning, '21)

in the adult as an epithelially lined pocket from 2 to 7 mm deep or even as a submucous tunnel extending backward along the entire length of the nasal septum (For a bibliography on the vomeronasal organ see Stupka 1938)

The Separation of Lips and Gums and the Formation of Teeth

THE DENTAL AND LABIAL LAMINAE

The primordia which give origin to the lips, gums and teeth are so closely interrelated

during development that it may be well to consider them together in a single discussion. It is of interest to note that in vertebrates below the mammals the lips and gums are un separated (Anson, 1929) It is not surprising ning from a point slightly closer to the region which is to become the lip a second band of cells the *labiogingival lamina* sinks below the surface to separate the future lip from the future gum This leaves a wedge of mesen-

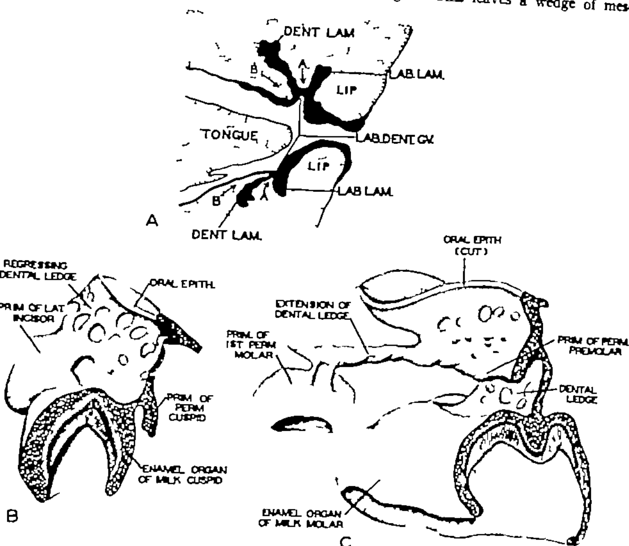


Fig 29 Early stages in the formation of lips and teeth
A. The dental and labial laminae seen in a sagittal section of a fetus in the third month (From Keith 33 ter Anson '29)
B Oral epithelium showing the dental ledge (undergoing regression) and developing tooth primordia
C. A stage more advanced than that in "B" showing an extension of dental ledge giving rise to the enamel gan primordia of the permanent molars. (B and C redrawn from Patten 46 based upon the reconstructions Röse.)

erefore, to find that prior to the seventh week man s development there is an arrangement rresponding to this earlier condition To- rds the end of the second month (seventh ek) there develops around the arc of each a band of thickened oral epithelium. Later the eighth week) this band which forms the *tal ledge* or *dental lamina* may be said to k into the subjacent mesenchyme Begin chyme interposed between the two laminae[2] (Fig 29 A) The mesoderm projecting upwards

[2] While it is convenient to describe the process in this manner Frazer (1932) has shown that the lamina tion is achieved by a procedure which is quite the reverse i.e the mesenchymal tissue sends projections toward the surface and separates two epithelial laminae an inner or dental lamina and an outer labio gingival lamina

lateral to the dental lamina becomes the labial or villous part of the gum ("A" in Fig 29 A), the ridge to the oral side of the lamina becomes its smooth or lingual surface ("B," in Fig 29 A) The labiogingival groove, which deepens along the plane of the labiogingival lamina, accomplishes the separation of lips and cheeks from the gums by the end of the tenth week and establishes the vestibule of the mouth The failure of the groove to deepen so markedly in the midline leaves a connecting sheet which arches between lip and gum, the *frenulum*

THE DEVELOPMENT OF THE TEETH

Phylogenetically the teeth are dermal organs consisting of an inner calcified material, the dentine, capped by the harder shell of enamel Dentine is derived from the connective tissue layer of the skin, while enamel is produced by the epithelial layer The similarity in origin of primitive types of teeth and our own may not, at once, be apparent unless one remembers that our teeth forming *within* the gums, derive their enamel layers from epithelium which has reached down to associate itself with the more deeply placed mesenchymal component (root) The similarity is even more obvious when it is realized that the teeth derive their epithelial components from the lining of the stomodaeal portion of the oral cavity the ectoderm

The enamel. In the third month the inner or deep margins of the submerging dental laminae of upper and lower jaws produce a series of ten epithelial buds each. These buds, the *enamel organs* furnish the enamel for the first, or milk teeth As each enamel bud develops, it encounters a mesodermal condensation the *dental papilla* which it surrounds (Fig 29 B) The ectodermal cells in contact with the dental papilla become the *ameloblasts* (enamel-producing cells) and deposit in their bases an enamel coating for the papilla Each ameloblast becomes, finally an enamel fiber but the more superficial parts of the cells remain to form a *cuticular membrane* (Nasmyth s membrane) which is still present at birth, but which is soon worn away While the events just outlined are occurring provision is already being made for the enamel covering of the permanent teeth As shown in Figs. 29 B and C, and 30 A), a side branch arises from the dental lamina to form the enamel bud for a permanent tooth

Dentine Numerous odontoblastic cells in the dental papilla deposit the *dentine* or ivory substance of the tooth This material is deposited successively in the crown, neck, and finally, in the root of the tooth The inner most core of the dental papilla remains as a matrix of cells which invests the vessels and nerve of the tooth (Fig 30 A and B)

PRACTICAL CONSIDERATIONS

Ordinarily the portion of the dental lamina which extends from the alveolar margin to the germs of the deciduous teeth is gradually disrupted and absorbed, beginning in the fifth month (Fig 29 B and C and Fig 30 B) The stalk by which the enamel bud of a permanent tooth arises from the denta laminal likewise breaks down (Fig 29 C) However, epithelial shreds are to be found in the alveolus up to the end of fetal life or even later As often occurs where surface layers become submerged during development remnants remain which may give rise to cysts whose contents vary with the potentialities of the residual cells. Thus, cysts or *odontomas* with epithelial walls occasionally develop in the jaws. They may be fluid-filled or contain teeth or other dermal derivatives Odontogenic tumors are the most common type of tumors to be found in the jaws and may be composed of any or all of the tissues of a normal tooth Depending upon their germ layer of origin, they may be epithelial, mesenchymal, or composite odontomas. When found such growths may appear to arise from the tooth itself, its follicle or any of the immediately adjacent tissues. They may form at any position in the jaws but do so primarily in the region of the third molars. Enamel nodules may arise from aberrant vesicles of ameloblasts associated with the enamel organ or derived from remnants of the dental ledge These 'pearls may be adherent to a tooth or lie free in the nearby connective tissue An additional source of buried epit

ORAL EPITHELIUM
YOUNG CONNECTIVE TISSUE
DENTAL LEDGE
ACCESSORY ISTHMUS
ENAMEL ORGAN OF MILK TOOTH:
OUTER EPITHELIUM
STELLATE RETICULUM
INTERMED LAYER
AMELOBLAST LAYER
ODONTOBLAST LAYER
ISTHMUS
PRIMORD OF ENAMEL ORGAN OF PERM TOOTH
MESENCHYMAL PRIMORD OF PULP
BONE OF ALVEOLAR SOCKET
MECKEL'S CARTILAGE
A

ORAL EPITHELIUM
DENTAL LEDGE AND ISTHMUS (DEGENERATING)
YOUNG CONNECTIVE TISSUE OF GUM
ENAMEL ORGAN OF MILK TOOTH
OUTER EPITHELIUM
STELLATE RETICULUM
INTERMED LAYER
AMELOBLAST LAYER
ENAMEL
DENTINE
ODONTOBLAST LAYER
MESENCHYMAL PRIMORD OF PULP
BONE OF MANDIBLE
B

Fig. 30

A. Section through a lower central incisor of a 14-week embryo.
B. Section through a lower central incisor of a 19 week embryo. (For description see labels and text.) (Redrawn from Patten, 46. Courtesy B. M. Patten and the Blakiston Co. Phila.)

cells is found in the fibrous capsule (dental sac) which surrounds an unerupted tooth and contains residual portions of the enamel organ For a more extensive discussion of dental cysts and tumors, the reader should consult Thoma's "Oral Pathology" (1944)

THE SALIVARY GLANDS

Simultaneous with the provision of a definite chewing apparatus in the mammals, there appears a number of oral glands known as the salivary glands. In man nearly the entire mucous lining of the oral and pharyngeal regions is dotted with small glandular structures. In mode of origin and function these glands resemble the larger salivary glands associated with the oral cavity and are collectively designated as the minor salivary glands. In addition to these, three pairs of large or major salivary glands develop and according to their locations, are termed the parotid, submaxillary and sublingual glands.

In general, the pattern of origin is similar for all the oral glands. They arise as epithelial buds and by a variable amount of branching develop into a system of solid ramifying cords with small terminal enlargements, the acini Later canaliculization of the solid cords gives rise to the characteristic collecting system of ducts. The cells of the acini become specialized for secretion Invasion of the glands into the deeper tissues provides them with an investment of mesenchyme which forms their capsules and partitions them into lobules.

The germ layer which gives rise to the major glands cannot be named with certainty for subsequent to the rupture of the oral membrane there is no distinct line of demarcation between stomodaeal ectoderm and foregut entoderm [1] While the salivary ducts (marking the points of origin of the glands) open close to the probable line of separation between the two germ layers, the major salivary glands are customarily regarded as ectodermal derivatives. However it is certain that the minor glands arise on either side of the zone of transition, since those in the lips must be ectodermal, while those about the base of the tongue (a pharyngeal derivative) must derive from entoderm Histologically, there are no structural differences in these glands which would point to a difference in their origins.

The Major Salivary Glands

The parotid. The primordium of the parotid duct begins to burrow into the deeper mesenchyme at about the middle of the sixth week The ingrowth proceeds from the groove between the cheek and jaw from a point near the angle of the mouth (Fig 31) This flange like growth lengthens and becoming hollow grows backward toward the ear Near the ramus of the mandible the duct produces numerous branching cords and develops as outlined above. By the fifth month acinal cells are in evidence.

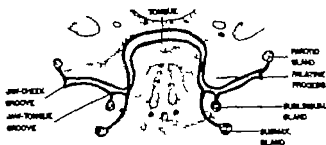


Fig. 31 Diagram of a section across the jaws at about the eighth week to show the sites of origin of the major salivary glands. (Redrawn from Arey, 46. Courtesy L. B Arey and W B Saunders Co., Phila.)

Submaxillary and sublingual glands. Just prior to the seventh week of development the depression between the tongue and lower jaw exhibits two linear grooves. The furrow lying nearest the tongue gives rise to the submaxillary gland Slightly later (seventh week) the

[1] The picture is complicated by a considerable displacement caudad of the dorsal line of union of the two germ layers. The position of Rathke's pocket (an ectodermal evagination just rostral to the oral membrane) is, in the adult a point high in the pharynx beneath the sphenoid bone The plane separating ectodermal and entodermal derivatives probably passes from this point in the pharynx, downward and forward, to the floor of the mouth near the gingiva. Accordingly the roof and much of the walls of the mouth are ectodermal.

more lateral groove marks the beginning of the sublingual gland. *There is some difference* in the patterns of development of the salivary glands from these two primordia.

Late in the sixth week, the primordial cords of the submaxillary glands appear beginning at either side of the *midline in the groove* between the jaw and tongue (Fig 31) Each cord which will form the duct grows dorsally at first along the floor of the mouth then turns caudally near the angle of the mandible. Having rounded the dorsal *margin of the mylohyoid* muscle the duct begins *to form its system of* branches. The orifice of the duct becomes raised upon a papilla, the *sublingual caruncle*

While the glands considered thus far arise as single *epithelial outgrowths, each sublingual* gland consists of a group of smaller glands which become consolidated within one connective tissue capsule. At the end of the seventh or the beginning of the eighth week *the primordia of about ten small glands appear* in a row under either side of the tongue. Although more or less collected into a single glandular structure the individual ducts are retained. One duct somewhat larger than the rest is termed the *duct of Bartholin*

The Minor Salivary Glands

This group comprises a large number of minute glands which are named according to *their locations*, the labial, buccal, and palatine glands, anterior lingual glands, and molar glands (four or five mucous glands) around the opening of the parotid ducts.

PRACTICAL CONSIDERATIONS

Accessory masses of salivary tissue sometimes occur evidently as *detached portions* of the major glandular elements or from cells of the oral epithelium having a marked potentiality for the production of salivary tissue. Retention cysts occur not infrequently as a result of imperforate ducts *Just* behind the origin of the parotid gland an ectodermal outgrowth, known as *Chievitz's organ* develops from the epithelium of the cheek It is usually seen between the second and sixth months and may represent a vestigial salivary gland (Broman 1916) Although it usually disappears, it may sometimes contribute to the parotid gland The gland is said to be a source of teratomatous tumors

THE PHARYNX

The pharynx, in a phylogenetic sense is extremely ancient. While in man it no longer serves its original *function as a respiratory* organ, the developing pharynx, nevertheless, *exhibits features which* are clearly reminiscent *of this earlier role. Having produced* a pharynx modelled as though in anticipation of respiration in an aquatic *environment*, the embryo is faced with the problem of remodeling the region *to suit the needs of an air* breathing animal The transformation is accomplished most skillfully and in a remarkably short period of time. After a transitory existence of about two weeks, the gill like apparatus disappears and from it *there develop parts of* the face, the jaws, the external ear tongue, and numerous arteries, muscles, cartilages, bones, and glandular structures. In accordance with its antiquity the pharynx begins its differentiation while the *embryo is still quite young* When only about fourteen somites have been *formed* and the central nervous system is *not yet completely* rolled up into a tube, structures strongly resembling gills put in their appearance It is at this stage that the primordia of most of the organs, which are destined to arise from the *pharyngeal epithelium are formed*. By the time the pharynx begins to resemble that of an air breathing animal *many of its* derivatives have migrated to other regions some of them to points relatively remote from their original sites. It is the rapid sequence of events leading from the formation of these structures to their *distribution which must be* outlined here

The Early Development of the Pharyngeal *Region*

As shown earlier the pharynx is a modified portion of the cephalic end of the foregut beginning immediately caudal to the position

of the oral plate This part of the foregut becomes dorsoventrally flattened and is cor respondingly increased in width (Fig 36 p 57) Beginning at the third week of development a series of bar-like ridges with furrows between them, the branchial arches and clefts, begins to appear A brief outline of the changes which give rise to these structures follows

A series of five shallow paired sacculations, the *pharyngeal pouches*, are produced in the entodermal lining of the lateral pharyngeal wall At corresponding positions on the sur face of the embryo the ectoderm becomes in dented to form the *branchial grooves* In this way the ectoderm is brought into close re- bars extend ventrally toward the midline, while dorsally, they are attached to the sides of the head In this manner a series of five bars is formed, but only four are visible on the surface of the embryo The first ones to appear are the first and second, or *mandibular* and *hyoid arches* and are easily distinguished in an em bryo of three weeks development (fourteen somites) The remaining ones appear in sequence, being termed the postoral arches, and are designated simply by number The mesodermal condensations later come to lodge car tilaginous bars having right and left halves and each is associated with one of the primi tive aortic arches.

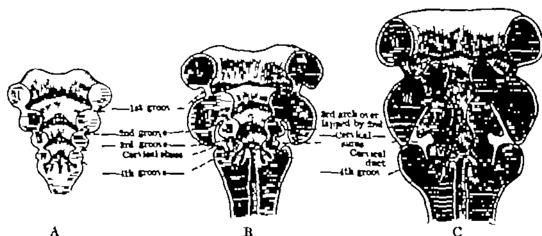


Fig 32 Schema showing early development of the pharyngeal wall

A. Shows proximity of ectodermal floor of branchial clefts to the entodermal pharyngeal pouches.
B Rapid growth of the hyoid arch (II) overshadows postoral arches, forming the cervical sinus.
C Occlusion of the cervical sinus (Note its position lateral to groove and pouch III and its communication with grooves II and IV) (From Cunningham, 43 Courtesy Oxford Press, London)

lationship with the entodermal lining of the pharynx and the floor of each groove becomes a delicate *closing membrane*, separating the cavity of the foregut from the exterior (Fig 32 A) In animals destined to bear gills, these membranes finally disappear so that the bran chial grooves become *branchial* or *gill clefts* However in higher forms, i.e. birds and mam mals, this perforation does not normally occur and the inner and outer germ layers again become separated by an intervening layer of mesoderm

Between the grooves the mesoderm thickens to form a series of arch like bars, the *branchial* or *visceral arches* Through elongation, these

Through their rapid growth the first two arches soon overshadow the remaining ones, so that the latter come to lie at the bottom of a depression called the cervical sinus (Fig 32 B and Fig 44 A) Downward growth of the hyoid arch narrows the entrance of the sinus until its aperture is closed (For details of this process, see p 65) The remains of the second, third and fourth branchial clefts open into the cervical sinus through branchial ducts. Sub sequently, the cervical sinus is first closed off from the surface and then the buried spaces become completely obliterated (Failure of the spaces to disappear or to separate from the surface may result in branchial cysts or fistulae

in the adult. See later) Contrary to many accounts, the buried cervical sinus is not lost completely but its ectodermal lining unites with the entoderm of the third branchial pouch to take part in the formation of the thymus gland (Norris, 1938)

The Derivatives of the Branchial Arches[4] and Their Ectodermal Coverings

The first branchial arch. The paired lateral bars of the mandibular arch extend ventrally to meet in the midline The arch contributes substantially in the formation of the face supplying the mandible chin lower lip lower parts of the cheeks, tooth enamel as well as surface coverings for the lower face, anterior half of the auricle, and much of the oral cavity Perhaps the submaxillary and sublingual salivary glands also derive from the first arch ectoderm (See p 49) The maxillary process, growing ventrally from the dorsal end of the first arch forms the upper parts of the cheeks and palate, and helps form the upper lip It is recalled that a mesenchymal condensation in the first arch forms Meckel's cartilage which serves as a temporary scaffolding for the mandible (Fig 23 B) With the bending forward of the dorsal portion of the mandibular arch the condensed mesenchyme which forms the first arch cartilage is also bent, and this portion becomes included in the maxillary process. Becoming chondrified this inclusion forms a small cartilaginous mass in the maxilla and it is said to represent the *pterygo-quadrate bar* of lower vertebrates. With the ossification of the mandible, the portion of Meckel's cartilage within it disappears, but the part extending from the mandibular foramen to the otic region persists as a chain of structures including the *sphenomandibular ligament anterior ligament of the malleus* and the *malleus* (Fig 33 A and B) The *incus* is considered by some to be a derivative of Meckel's cartilage by others, a representative of the pterygo-quadrate cartilage

The second branchial arch The cartilaginous bar associated with the hyoid arch (*Reichert's cartilage*) is also connected to the otic capsule dorsally Its dorsal tip separates, giving rise to the *stapes* which becomes articulated with the other middle ear ossicles (Fig 33 B) In sequence dorsoventrally the remainder of the hyoid arch becomes modified to form the *styloid process stylohyoid ligament lesser cornu* of the hyoid and in combination with the third arch the body of the hyoid bone The ectodermal covering of the hyoid arch gives rise to the epidermis of the dorsal half of the auricle and upper part of the neck

The third branchial arch. The cartilages of the third arch become the *greater cornua* of the hyoid bone The ventral ends of both the second and third arches unite and meet with their fellows of the opposite side to form the *body* of the hyoid bone The third arch ectoderm supplies the epidermis of a skin area in the middle neck region corresponding to the anterior cervical triangle

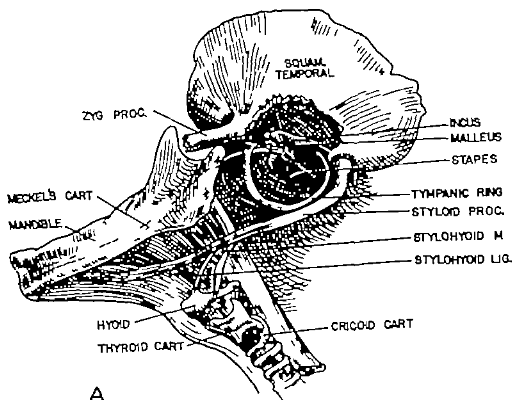
The fourth branchial arch. The fourth arch cartilages give origin to the *thyroid cartilage* of the larynx Its ectoderm shares the fate of the cervical sinus (*vide infra*)

The fifth branchial arch The fifth arch cartilages supply the group of structures closely associated with the thyroid cartilage the *corniculate arytenoid* and *cricoid cartilages*

The Derivatives of the Pharyngeal Lining

From [illegible] dermal lining of the branchial arches [illegible] lations between the latter there [illegible] number of structures of [illegible] dely [illegible] function and location [illegible] a [illegible] the upper [illegible] passages [illegible] achian [illegible] part

[4] Admittedly the term "branchial" is poorly used here. The visceral arches of the human embr[illegible] correspond numerically to the branchial ar[illegible] The human embryo never possesses branc[illegible] so that terms such as "branchial arch," [illegible] genic cysts," et cetera, are not apt ones. H[illegible] terms are widely used in the literature and [illegible] Therefore they [illegible] for the [illegible]



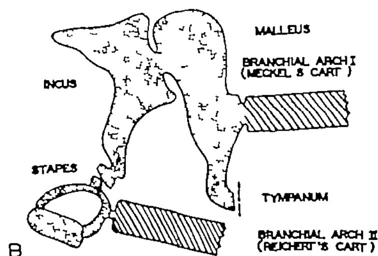


Fig 33

A. Sketch of mandible and middle ear region to show relationship of the proximal end of Meckel's cartilage to components associated with the middle ear (Adapted from Kollman '07)

B. Schema to illustrate the origin of the auditory ossicles from branchial arches I and II (From Arey '46. Courtesy L. B Arey and W B Saunders Co Phila.)

to such organs as the tongue and tonsils and to glands including the thyroid thymus, and parathyroids.

PHARYNGEAL POUCH I

Eustachian tube tympanic membrane, and middle and external ear In Fig. 32 it is seen that only the first branchial cleft remains exposed to the surface, the others being submerged in the cervical sinus. The broad lateral extension formed by the first pouch reaches dorsally to expand into the *tympanic cavity* of the middle ear, its proximal stalk remains as a constricted *pharyngo-tympanic tube* Meanwhile, the first ectodermal groove deepens and becomes the external auditory meatus. Together, the entoderm of the tympanic cavity, the ectodermal floor of the first branchial

groove and an intervening layer of mesoderm form a closing plate which persists as the tympanic membrane[a] (Fig 34)

The auricle results from the coalescence of a number of tubercles arranged about the opening of the first branchial cleft. These arise from both first and second arch components, so that the *tragus* and *crus helicis* are derivatives of the mandibular arch the remaining portions of the auricle are derived from the hyoid arch (Streeter, 1922)

Rarely and usually in combination with agenesia of the mandible the auricles may be placed obliquely on the sides of the neck with their lobes near the midline. In this condition, failure of the mandible to force the ears laterally to the sides of the head apparently permits the auricles to remain at the location of the original hyomandibular clefts.

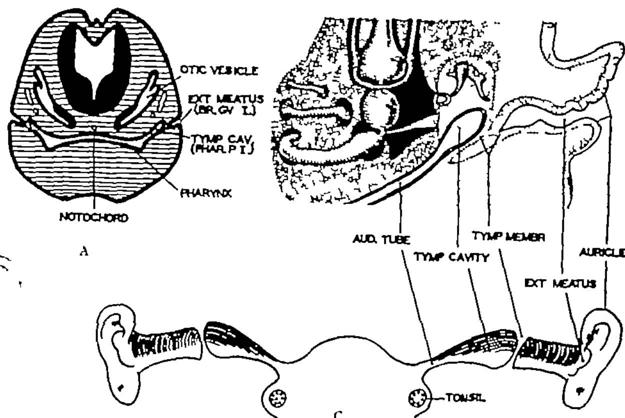


Fig. 34 The role of the first pouch and cleft in the formation of the auditory tube middle and external ears.
A. Diagram of a section through the head of an embryo of 6 weeks The lateral extensions of pharyngeal pouch I approach the floors of branchial grooves I
B Schema of middle and external ears of an embryo of 3 months Ectodermal and entodermal components are separated by a layer of mesoderm
C. Schema of pharynx, auditory tube and ear with tonsil lodging in pharyngeal pouch II (A and C after Cunningham, 43 Courtesy Oxford Univ Press, London B redrawn from Arey 46. Courtesy L B Arey and W B Saunders Co., Phila.)

Practical considerations. Residual masses of connective tissue which originally surrounded the middle ear ossicles (Fig 34 B) may form scar tissue following otitis media and damp their movements.

[a] The adjacent portion of the second pharyngeal pouch may also contribute to the formation of the Eustachian tube.

PHARYNGEAL POUCH II

The tonsils. The second pharyngeal pouch originally almost as capacious as the first pouch becomes relatively less extensive as development proceeds Toward the end of the second month of fetal life the second pouch is a shallow depression at either side of the base of the tongue at the area of transition from the oral to the pharyngeal cavity At the end of the third month a lymphoid infiltration of the second pouch area signals the formation of the

palatine tonsils. The tonsillar crypts arise from epithelial invasions of the growing lymphoid mass. Much later in development the crypts branch and penetrate deeply into the tonsil. Above each tonsil a small recess, the *supratonsillar fossa*, persists and marks the position of the second pharyngeal pouch.

Other, less well organized clumps of lymphoid tissue of the pharyngeal region develop in the roof of the nasopharynx ('adenoids') and on the root of the tongue (lingual tonsil).

The tongue. From the standpoints of its mode of development and innervation, the tongue may be considered a compound structure. The membranous sac which serves as a covering for the tongue is derived from the first three or four visceral arches and, of these, chiefly from the first or mandibular arch. There exists strong evidence that most of the sac's contents, i.e. the lingual muscles, do not develop *in situ* but begin their development probably in head somites and migrate secondarily into the floor of the oral cavity. Briefly, the main features of tongue development are as follows.

In an embryo of four to five weeks development, the floor of the oropharynx exhibits a number of lateral and median swellings. The inner surface of the mandibular arch develops paired *lateral lingual swellings* (Fig. 35 A). In the midline between these swellings and between arches I and II is an unpaired eminence, the *tuberculum impar*. Extending caudally from the tuberculum impar to the epiglottic primordium is the second median swelling, the *copula*, which joins the lateral portions of both second and third arches. With the rapid proliferation of the epithelium and mesenchyme of the first four arches, these structures become less easily distinguished and merge to form, by the seventh week, a recognizable tongue (Fig. 35 B).

While one cannot state with certainty which areas of the definitive tongue represent the contributions of individual primordia, one landmark persists even in the adult, namely, the *foramen caecum*. Since the foramen caecum is placed just caudal to the tuberculum impar, and since it is customary to regard the foramen caecum as the boundary between the body and root of the tongue, it is certain that the body of the tongue is covered by first arch derivative, while the root epithelium (entoderm) is derived from the midventral areas of the second, third, and part of the fourth arches. The probable distribution of surface areas of different embryologic origin is illustrated in Fig. 35. Although the tongue shows no evidence of the point of continuity between ectoderm and entoderm, it appears certain that most of its body is covered by stomodaeal ectoderm, while the basal portion (caudal to the foramen caecum) is clothed in pharyngeal entoderm.)*

Practical Considerations. The bilateral origin of the tongue (lateral lingual swellings and paired muscle primordia) undoubtedly explains the occurrence in the tongue of a bifid tip, relatively small bleeding from midline incisions and the formation of cysts in the median raphé.

The Glandular Derivatives of the Pharyngeal Entoderm: Thyroid, Parathyroid, and Thymus

The main features of thyroid, parathyroid, and thymus development are now known and the points of origin and paths of migration of each may be described in some detail. Certain of these glands are intimately related at their origins and some become closely associated during their migrations or in their definitive positions. Therefore, in order to emphasize the positional relationships of thyroid, parathy-

* Innervation. In view of the derivation of the tongue's covering, it is not surprising that the body of the tongue receives its sensory innervation from nerves associated with the mandibular arch (V, Mandibular branch, and VII, chorda tympani) and the root, its innervation from the cranial nerves IX and X. Much of the muscular portion of the tongue can be shown, phylogenetically, to arise at a more caudal level, probably from occipital myotomes. This premuscle mass opposite the hypoglossal nerve merges so rapidly and imperceptibly with the mesenchyme of the oral floor that its path cannot be followed in the embryo. However, the pathway of migration of these bilaterally placed masses is clearly traced by the characteristic course taken by their nerves (XII).

roid, and thymus, and also to avoid needless repetition, it will prove expedient to consider some or all of the glands jointly in certain portions of the discussion. The account given here is based substantially upon the thorough and careful studies of Weller (1933) and Norris (1937, 1938).

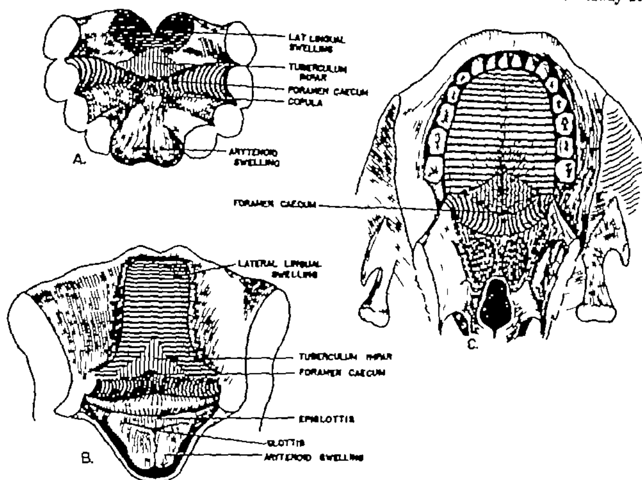


Fig. 35. Sketches of stages in the development of the tongue.
A. Floor of oro-pharyngeal region at 4 weeks.
B. Similar view in the middle of the seventh week.
C. The adult condition. Comparable areas in A, B and C show similar shading. For explanation see text. (Modified from Corning '21.)

THE THYROID

Of all the primordia of the glands under consideration, the median component of the thyroid arises at the highest level and in point of time is the first to make its appearance. The thyroid arises from a median unpaired outgrowth of the ventral pharyngeal wall and a pair of lateral components derived from the fourth pharyngeal pouches.

Median thyroid. The so-called median thyroid is seen late in the third week of development as a well-defined fold in the ventral wall of the pharynx. It arises as a proliferation of pharyngeal cells and soon assumes a spherical shape (Fig. 36 A and B). In the 4 mm. embryo (about 4 weeks) the median *thyroid* appears as a small mass situated midway between the tonsillar primordia. With further growth the thyroid primordium becomes bilobed and because of the curvature of the pharynx, it stands out well in front of the primitive larynx (Fig. 37 A and B). The Y-shaped appearance of the gland is more evident by the fifth week when the bilobed structure is connected to the pharynx by a stalk or pedicle, the *thyroglossal duct* (Fig. 37 C). In the sixth week this connection is ordinarily lost and definite lateral lobes are present with a con

necting piece, or *isthmus* (Fig 37 D) The lateral lobes become broad plates which together form a U-shaped structure suspended across the ventrum of the pharynx (Fig 37 E) The tips of the primordium curl dorsally around the carotid arteries. With the severing liferation of the entoderm of the fourth pharyngeal pouch. Its area of origin involves the medial and ventral parts of the pouch and most of its cephalic and caudal surfaces (Fig 36 and Fig 38, A and B) At first the lateral thyroids differ from the median component

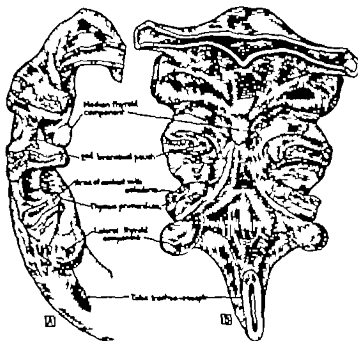


Fig 36
A. Lateral view of pharyngeal and primordial epithelium in the 4 mm. embryo. Note ventral positions of medial and lateral thyroid components
B Ventral aspect of pharynx. The median thyroid primordium is just cephalad to and between the tonsillar primordia of the second pouch. (From Weller 33 Courtesy Carnegie Institution of Washington)

of the thyroglossal duct, the median thyroid is completely free of the pharynx. However, its point of origin is still evidenced by a pit in the midline of the tongue just caudal to the tuberculum impar This depression, the *foramen caecum* remains as a more or less easily distinguished landmark and is commonly seen at the base of the tongue in the adult (Figs. 35 C and 43)

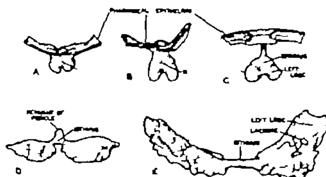


Fig. 37 Stages in the development of the median component of the thyroid Sketches A through E represent, in sequence the stages seen in 4.5 6.5, 8.2 11 and 13.5 mm. embryos. (Redrawn from Weller '33 Courtesy Carnegie Institution of Washington)

THE FOURTH BRANCHIAL POUCH

The lateral thyroid[7] and parathyroid IV Somewhat after the appearance of the median component of the thyroid the lateral thyroid primordium arises by a rapid cellular pro- at the same stage only in point of position The three thyroid primordia then mark out a triangular area on the ventral surface of the pharynx Each is hollow and its lumen communicates with the pharyngeal cavity

[7] This is the terminology introduced by Born (1883) and employed by Weller (1933) and Norris (1937) The lateral thyroid has also been called by other terms including *ultimobranchial body* and *postbranchial body*

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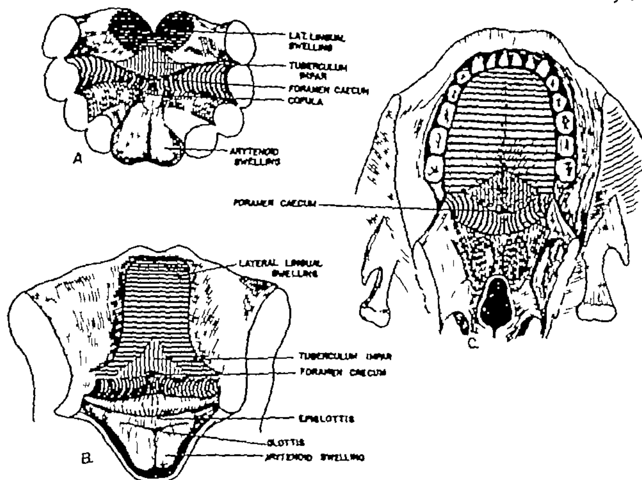


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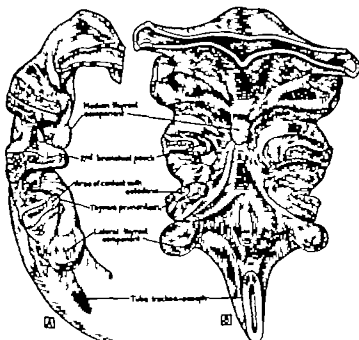


Fig 36

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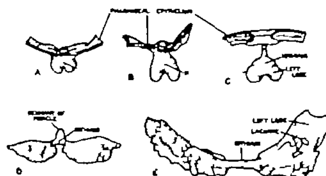


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at the same stage only in point of position The three thyroid primordia then mark out a triangular area on the ventral surface of the pharynx Each is hollow and its lumen communicates with the pharyngeal cavity

The series of sketches shown in Fig 38 illustrates stages in the growth of branchial pouch IV derivatives and the establishment of permanent relationships. Sketches A and B show the simple, tubular fourth branchial pouch as it pushes laterally to make a brief contact with the ectoderm of the fourth branchial cleft. A dorsal bud-like nodule marks the pharynx becomes attenuated and finally pinches off (Fig 38 D) While the median thyroid migrates for a considerable distance caudally there is very little shift in the position of the fourth branchial complex. The rapidly expanding lateral lobes of the median thyroid grow laterally and dorsally to meet and fuse with the lateral thyroid component Gradually

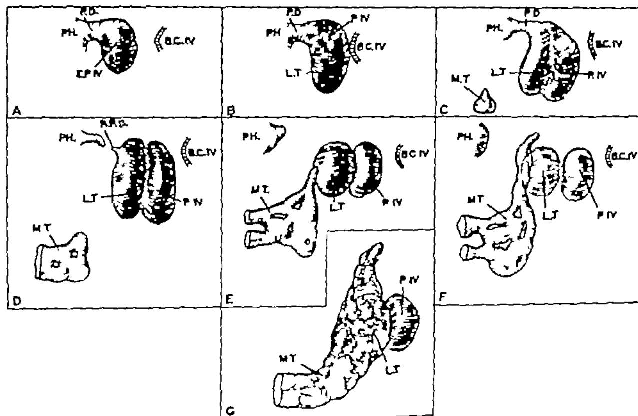


Fig 38. Schema of the morphogenesis of the fourth branchial pouch and its derivatives, seen from ventral.
A. Simple fourth branchial pouch approaching floor of branchial cleft IV
B Elongation of pouch to form the lateral thyroid primordium.
C. Rapid growth of parathyroid IV in intimate relationship to lateral thyroid.
D Dorsal extension of median thyroid lobe approaching the fourth branchial complex separation of complex from pharynx
E. Contact of median thyroid lobe with the lateral thyroid.
F Beginning of incorporation of lateral thyroid within lobe of median thyroid
G Fusion of median and lateral thyroids. B C IV Fourth branchial cleft E P IV Fourth entodermal pharyngeal pouch. L.T Lateral thyroid. M T Median thyroid. P IV Parathyroid IV P D Pharyngo-branchial duct Ph., Pharynx. R P D Remnant of pharyngobranchial duct (Redrawn from illustrations by E. Erickson in article by Norris 37 Courtesy Carnegie Institution of Washington)

origin of the parathyroid derivative of the fourth pouch (parathyroid IV) The parathyroid portion spreads narrowly onto both anterior and posterior surfaces of the pouch and through rapid growth soon attains the size of the lateral thyroid primordium (Fig 38 C) The pharyngo-branchial duct which connects the fourth branchial complex to the body of the the lateral thyroid becomes incorporated in the substance of the median thyroid Norris (1937) saw no degeneration of the lateral thyroid, but rather a large number of mitotic figures. Where the lateral thyroids fuse with the median thyroid lobes there is a distinct increase in the mass of the latter the lateral thyroid in man contributes in an essential

manner to the tissues of the definitive thyroid (Fig 38 E, F, and G) Parathyroid IV remains attached to the lateral thyroid until about the seventh week. Therefore, the position of para thyroid IV with respect to the thyroid gland floor of the third branchial groove (Fig 39 A) In either case, the pouch makes contact with the overlying ectoderm to form a branchial membrane, but whereas the fourth pouch makes only a brief and narrow contact and

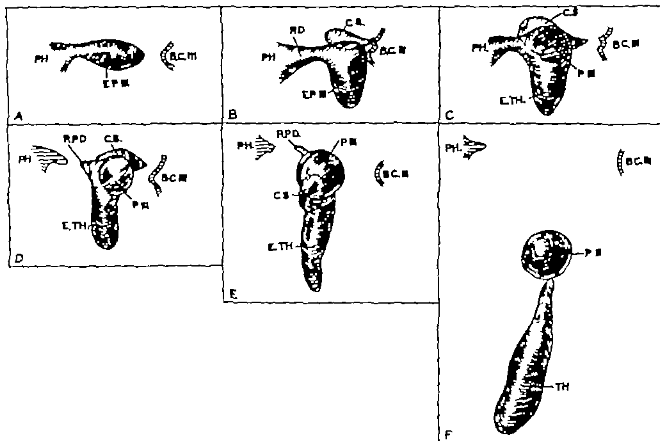
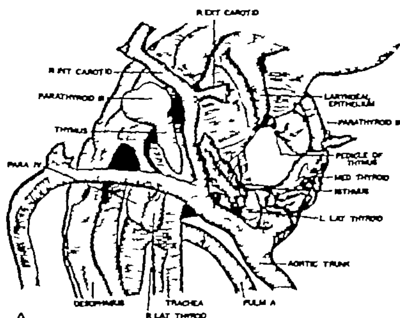


Fig 39 Schema of the morphogenesis of the third branchial pouch and its derivatives, seen *from ventral*.
A. Third branchial pouch approaching the floor of branchial cleft III.
B. Elongation of third pouch into the primordium of the thymus. Early association of the cervical sinus with the thymus.
C Appearance of the primordium of parathyroid III at the cephalic end of the pharyngeal pouch. Separation of ectodermal sinus its dorsal relationship to the upper end of the thymus.
D Complete separation of third pouch derivatives from the pharynx.
E Growth of parathyroid III and elongation of the thymus beginning of isolation of third branchial complex components.
F Caudal migration of thymus B C., III Branchial cleft III C.S., Cervical sinus. E.P III Third entodermal pharyngeal pouch. E.Th. Entodermal thymus. P III, Parathyroid III. P D Pharyngo-branchial duct. Ph. Pharynx. R.P D., Remnant of pharyngo-branchial duct. Th., Thymus. (Redrawn from illustrations by E. Erickson n article by Norris 37 Courtesy Carnegie Institution of Washington)

in the adult depends upon the site of inclusion of the lateral into the median thyroid

THE THIRD BRANCHIAL POUCH

The thymus and parathyroid III. The early history of the third pharyngeal pouch is not unlike that of the fourth pouch just con sidered It appears first as a simple tubular diverticulum of the pharyngeal entoderm which points laterally toward the ectodermal receives no ectodermal contribution, the con tact of the third pouch with ectoderm is broad and relatively lasting and it receives an incre ment from the ectoderm of the cervical sinus (*vide infra*) (Fig 39 B C, D, and E) Upon reaching the ectoderm the third pouch turns and continues its growth in a ventral direction Parathyroid III first appears as a localized proliferation and differentiation of cells on the cephalic surface of the third pouch while the



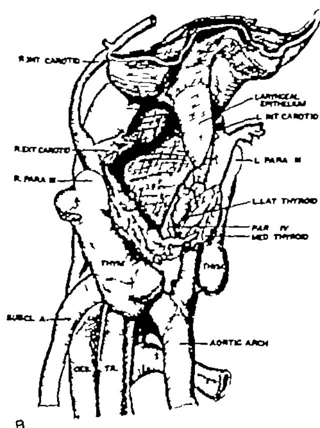


Fig. 40 Reconstructions of pharyngeal regions in human embryos

A. 14.5 mm. embryo (early 7th week) Median thyroid has descended and lost its connection with the pharynx The branchial complexes of pouches III and IV are still at their points of origin

B. 16.8 mm. embryo (late 7th week) Thymus and parathyroid III are descending through the neck Lateral thyroid is becoming incorporated in the lateral lobe of the median thyroid (Redrawn from illustrations by Didusch in article by Weller Carnegie Cont to Emb Vol 24 1933 Courtesy Carnegie Institution of Washington)

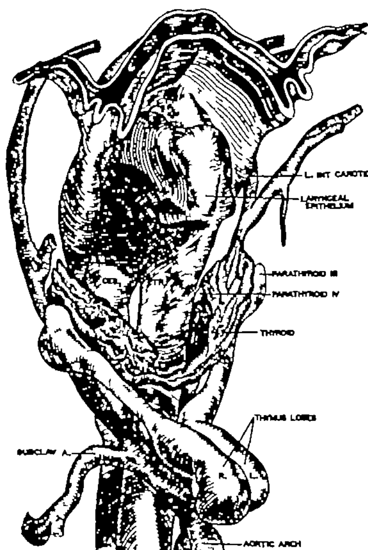


Fig. 41 Reconstruction of embryonic pharynx in the middle of the eighth week. Lateral thyroid is embedded within the median thyroid lobes. Thymus lobes are descending into thorax and parathyroids III are nearing definitive positions. (Redrawn from illustration by Didusch in article by Weller Carnegie Cont. to Emb. Vol. 24, 1933 Courtesy Carnegie Institution of Washington.)

remainder of the pouch is growing rapidly in the ventral direction to form the primordium of the thymus (Fig 39 C, D) As in the case of the fourth pouch, its pharyngo-branchial duct thins out and is finally severed There then exists on either side of the pharynx a pair of lobulated bodies derived respectively from the third and fourth pharyngeal pouches the upper representing parathyroid III and thymus the lower parathyroid IV and lateral thyroid Of the two complexes, that derived from the third branchial pouch is more lateral in position. At this stage, the lobes of the median thyroid are extending themselves laterally and dorsally and in so doing they push themselves between the third and fourth pouch derivatives.

The intimate contact of the members of the third branchial complex is maintained, but the rate of growth of the thymus far surpasses that of parathyroid III The thymus extends *rapidly in a ventral direction to reach the* pericardium and parathyroid III is left more or less in its original position as a spherical mass at the upper end of the thymus cord (Fig 39 D E Fig 40 Fig 41) With the formation of the embryonic neck and a caudal displacement of the heart, the thymus is dragged down through the entire extent of the neck and its attached parathyroid is carried along as far as its definitive position near the lower pole of the thyroid

One feature of the development of the thymus deserves especial mention During the time at which the third pouch is in contact with the ectoderm of the third branchial cleft, the floor of the cervical sinus becomes closely applied to the thymus primordium Contrary to many reports, the cervical sinus does not completely disappear rather it persists and is pinched off from the lining of the third branchial cleft to become permanently associated with the thymus. Through the painstaking work of Norris *(1938) it has been demonstrated that the cervi*cal sinus becomes incorporated in the thymus and that it represents the primordium of the primitive thymic cortex and the source of Hassall s corpuscles

Figures 40 and 41 will serve as a partial summary of the foregoing discussion since they show particularly clearly the migrations and changing relationships of the third and fourth pharyngeal pouch derivatives.

The Aftermath of Embryologic Accidents in the Cervical Region

In general, structures which have shifted to new locations during their development tend to vary more in shape, position, and relationships than structures which remain at or near their sites of origin It has been seen that nearly all the pharyngeal entodermal derivatives undergo real or relative changes in position Moreover the changes which occur are rather profound and at the same time, rapid ones. Accordingly the cervical region proves to be one in which a multitude of unusual conditions may be found. Keeping in mind the normal course of events in the production *and distribution of the various pharyngeal* derivatives, it is not difficult to explain many of the ectopic glandular masses cysts, fistulae et cetera, which present themselves as deviations from the standard pattern

The thyroid. Because of the compound nature of the thyroid gland its shape is subject to some variation Moreover the migration of its median unpaired portion affords ample opportunity for the occurrence of midline cysts and ectopic masses of thyroid tissue.

The median thyroid descends through the neck in a plane which is usually deep to the paired midline muscles (Geniohyoid and infrahyoid group) It may pass either dorsal or ventral to the developing hyoid bone or through it and then continue ventral to the thyroid and cricoid cartilages and upper tracheal rings. Usually the thyroglossal duct disappears soon after the gland has completed its migration However in the adult one and sometimes two structures remain to mark the first and last parts of the pathway The site of origin of the median thyroid the foramen caecum is seen at the junction of the anterior and posterior parts of the tongue (Fig 35 C Fig 43 and Fig 46) (The apex of the V

shaped pattern of the circumvallate papillae points accurately to its position.) The final steps of the median thyroid's course is represented by the cranially directed pyramidal lobe of the thyroid when this portion of the gland is developed (50 per cent of cases) The pyramidal lobe is frequently suspended from the hyoid bone by a fibrous band, which may be partially or completely occupied by a slip of muscle, the *levator glandulae thyroideae* Sometimes this suspensory band lodges one or more fragments of accessory thyroid tissue which have developed from remnants of the thyroglossal duct The ectopic thyroid tissue then appears in the form of small lobules lying between the infrahyoid muscles[8] Thus, the pyramidal lobe, its cranial fibrous extension, and ectopic thyroid bodies retrace the steps of the median thyroid as far cranial as the hyoid bone. Above the hyoid, the proximal portion of the thyroglossal duct may remain intact or in one or more discrete pieces The more cranial of these remnants may or may not preserve its connection to the foramen caecum A common site at which they appear is in the midline between the geniohyoid muscles. These remnants of the thyroglossal duct sometimes form thin walled cyst like structures or may bear glandular remnants having the appearance of thyroid tissue Thyroglossal cysts have been seen at all levels from the foramen caecum to the isthmus of the thyroid along the course of the original thyroglossal duct indeed, the duct may persist in its entirety (Fig 46) As pointed out by Hendrick (1936) the relationship of thyroglossal cysts to the cervical fascia depends upon the original course taken by the median thyroid If in its descent the thyroid rudiment were to pass ventral to the hyoid then cysts would lie superficial to the fascia colli. But if the thyroid's course were through or behind the hyoid, thyroglossal cysts would occur either between the fascia colli and the pretracheal fascia, or behind the latter (Fig 499 p 631)

[8] Aberrant nodules of thyroid tissue which occur to one side or the other of the midline are more difficult to explain but may represent detached fragments of the flat, plate-like lateral lobes.

Aside from the ectopic lobules mentioned above, sizeable masses of true thyroid tissue may be found at varying levels As extreme cases of the latter may be mentioned the occurrence of the median thyroid at the base of the tongue (Ward, 1949) and in the thorax, either above the aortic arch or even as far caudal as the pericardium (Hendrick 1949) In the first instance, the median thyroid has simply failed to descend Thyroid tissue in the vicinity of the aortic arch has probably descended to that level along with the vessel, since the median thyroid and aortic arch are closely related in an early stage (seventh week) The descent of thyroid tissue to the pericardium is probably the result of a partial fusion of thyroid and thymus primordia at a time when they were intimately related in the neck Thyroid fragments, pulled away by the caudal movement of the thymus would then migrate with the latter down into the thorax

Asymmetries of the lateral lobes of the thyroid are to be explained upon the basis of the variability of the point at which the lateral thyroid becomes incorporated with the median component The site at which parathyroid IV is applied to the thyroid likewise depends upon the place where lateral and medial thyroids fuse

The parathyroids and thymus. Aside from some variability in its position with respect to the thyroid, parathyroid IV is rather constant in its location Branchial complex IV (lateral thyroid and parathyroid IV), in general, is quite stable in its behavior It is recalled that after the fourth branchial complex is freed from the body of the pharynx there is little change in its position the lateral lobes of the median thyroid grow dorsally to meet it (Fig 38)

On the other hand, the components of branchial complex III (thymus and parathyroid III) wander far from their original sites (Figs 40 and 41) Accordingly thymus and parathyroid III show a marked tendency to deviate from their normal relationships (Fig 46) The

entire third complex may fail to descend, leaving the thymus and parathyroid III high in the neck. While the thymic cord usually releases its attached *parathyroid at the lower pole of* the thyroid the parathyroid sometimes remains attached to the thymus and descends *with it into the thorax* (Churchill and Cope, 1934) In other cases the parathyroid may not follow the thymus at all, or else be released prematurely to remain at or near its original position Furthermore, it is not uncommon for a bit of thymus tissue to remain associated with the parathyroid (Ungerman 1906 Gerard, 1928, Norris, 1937)

Infrequently, supernumerary parathyroids may be present. While there are numerous reports of six or more parathyroids (Schaper 1895 Kürsteiner 1898 Zuckerkandl 1902 Erdheim 1904 Millzner 1930 and others) Norris (1937) feels that such conditions are rare. (Norris found five parathyroids in only two out of 109 cases, or less than 2 per cent) Norris has shown how an extra parathyroid *might occur when the developing internal* carotid artery splits the primordium of a parathyroid III into two distinct parts. The portion of the gland which is attached to the thymus may then migrate in the customary manner while the other, isolated on the lateral side of the artery remains there as aberrant parathyroid tissue.

The thymus, through failure to descend as a unit to its definitive position sometimes leaves thymic fragments strewn along its pathway In other cases it may descend but leave a continuous trail of thymic tissue extending back to its point of origin (Fig 46) In some instances the thymus leaves a portion of its cranial pole attached to the thyroid along with parathyroid III but remains connected to its cervical fragment by a fibro-cellular cord (Groschuff 1900)

Numerous writers attribute a thymic derivative to pharyngeal pouch IV the supposed source of thymus fragments which on rare occasions are found close to parathyroid IV near the upper pole of the thyroid While the fourth pharyngeal pouch of lower mammals may give rise to thymus tissue the best evidence shows pharyngeal pouch III to be the only source of the thymus in man

Branchial cysts and fistulae[*] The manner in which the branchial clefts, pharyngeal pouches and cervical sinus are formed has been described (pp. 50 to 52) With the closure of the cervical sinus the clefts between the postoral arches become submerged and open into a common cavity (Fig 32 C) The possibilities for missteps at this stage of development are multiple. The closing membrane of a cleft may break through placing the cervical sinus and pharyngeal cavity in open communication The cervical sinus may fail to close off completely from the surface so that its connection to the outside persists. The sinus may submerge but maintain its cavity, leaving an epithelially lined space deep in the cervical region The combination of an open branchial cleft and a patent cervical sinus produces a continuous tract from the pharyngeal cavity to an opening on the surface. All such possibilities are fulfilled and either singly or in combination furnish a basis of explanation for such conditions as cervical sinuses branchial cysts, fistulae, and diverticulae in the adult Some of the conditions and the ways in which they may obtain are shown diagrammatically in Fig. 42. During later development such cavities become constricted and drawn out and in the case of branchial fistulae open upon the neck at a level which is caudal to that of the internal opening

The pharyngeal origin course and relationships of cervical fistulae are determined by certain primary relationships which are established in the embryo The point at which a branchial fistula opens into the pharynx depends, of course upon which of the pharyngeal pouches is involved. The first pharyngeal pouch as mentioned previously persists as the pharyngo-tympanic tube The lateral extremity of the first pouch never loses its intimate relationship with the floor of its corresponding cleft (hyomandibular) The remaining pouches never become as extensive as the first

[*] *See footnote 4 page 52, on the use of the term* "branchial."

one. The palatine tonsil develops in the lower portion of the second pouch In the adult, the only remnant of this pouch is to be seen in the depression immediately above the tonsil, the *supratonsillar fossa* The anterior pillar of the fauces represents the position of the second arch[18] (Fig 43) It will be recalled that the third and fourth pouches share similar fates, in that their bulbous distal portions become pinched off to drift away and give rise to various endocrine structures The insignificant



Fig 42 Series of diagrams to show how several kinds of tracts and cysts may arise through faulty development of the pharyngeal wall

A. Normal pharynx showing closure of cervical sinus.

B. Incomplete closure of cervical sinus forming the basis for a tract opening externally upon the surface of the neck.

C. Rupture of closing membrane leaving permanent opening into the position of the second pouch.

D Branchial fistula resulting from a combination of the conditions in B and C

E. Cystic remnant of the cervical sinus. (Based upon the schema seen in Fig 32 C)

lateral bays which remain at the proximal ends of the severed pharyngo-branchial ducts may still be found in the adult pharyngeal wall The pyriform fossa at either side of the laryngeal opening marks the original location of the third pouch. The site of the fourth pharyngeal pouch is less distinct in the adult than the others. It is at the lower end of the pharynx and is generally said to be somewhat dorsal to the third pouch being separated from the latter by the fold of the laryngeal nerve (plica, n. laryngis) (Fig 43) There is apparently no ancestral representation of either the fifth or sixth pouch in the fourth pouch of the human embryo (Norris, 1937), certainly nothing in the adult pharynx can be said to represent them.

[18] The pharyngeal recess (of Rosenmüller) was formerly held to be a remnant of the second pouch, but appears to be, rather a secondary development.

The superficial opening of the embryonic cervical sinus is somewhat slit like. Because of its linear extent, the external opening of a branchial fistula is variable in position, being

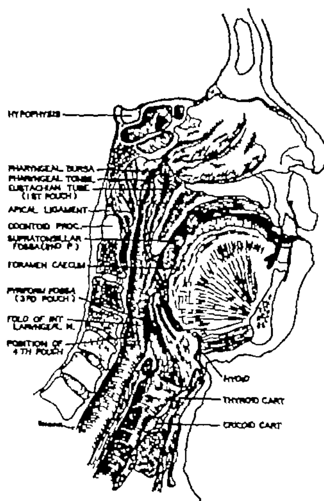


Fig 43 Hemisection of the adult head and neck showing the positions which correspond to the sites of the original pharyngeal pouches I–IV (From a specimen)

dependent upon the portion of the slit which remained patent An account of the fate of the cervical sinus which differs somewhat from others, but which accords well with findings in subjects with branchial fistulae is given by Frazer (1932) The series of drawings in Fig 44 based upon Frazer's work illustrates the manner in which the cervical sinus is closed superficially In the fifth week, as the hyoid arch begins to overshadow the postoral arches, the latter form the floor of a triangular field. The depressed area is bounded by the hyoid

entire third complex may fail to descend, leaving the thymus and parathyroid III high in the neck While the thymic cord usually releases its attached parathyroid at the lower pole of the thyroid the parathyroid sometimes remains attached to the thymus and descends with it into the thorax (Churchill and Cope, 1934) In other cases the parathyroid may not follow the thymus at all, or else be released prematurely to remain at, or near, its original position Furthermore, it is not uncommon for a bit of thymus tissue to remain associated with the parathyroid (Ungerman, 1906 Gerard, 1928, Norris, 1937)

Infrequently supernumerary parathyroids may be present While there are numerous reports of six or more parathyroids (Schaper 1895, Kürsteiner 1898 Zuckerkandl 1902, Erdheim, 1904, Millzner, 1930 and others) Norris (1937) feels that such conditions are rare. (Norris found five parathyroids in only two out of 109 cases, or less than 2 per cent) Norris has shown how an extra parathyroid might occur when the developing internal carotid artery splits the primordium of a parathyroid III into two distinct parts. The portion of the gland which is attached to the thymus may then migrate in the customary manner while the other isolated on the lateral side of the artery remains there as aberrant parathyroid tissue.

The thymus through failure to descend as a unit to its definitive position sometimes leaves thymic fragments strewn along its pathway *In other cases it may descend, but leave a con*tinuous trail of thymic tissue extending back to its point of origin (Fig 46) In some instances the thymus leaves a portion of its cranial pole attached to the thyroid along with parathyroid III but remains connected to its cervical fragment by a fibro-cellular cord (Groschuff 1900)

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Branchial cysts and fistulae.[9] The manner in which the branchial clefts, pharyngeal pouches and cervical sinus are formed has been described (pp 50 to 52) With the closure of the cervical sinus, the clefts between the postoral arches become submerged and open into a common cavity (Fig 32 C) The possibilities for missteps at this stage of development are multiple. The closing membrane of a cleft may break through placing the cervical sinus and pharyngeal cavity in open communication. The cervical sinus may fail to close off completely from the surface so that its connection to the outside persists. The sinus may submerge but maintain its cavity leaving an epithelially lined space deep in the cervical region. The combination of an open branchial cleft and a patent cervical sinus produces a continuous tract from the pharyngeal cavity to an opening on the surface. All such possibilities are fulfilled, and either singly or in combination furnish a basis of explanation for such conditions as cervical sinuses, branchial cysts, fistulae and diverticulae in the adult. Some of the conditions and the ways in which they may obtain are shown diagrammatically in Fig 42. During later development such cavities become constricted and drawn out and, in the case of branchial fistulae open upon the neck at a level which is caudal to that of the internal opening

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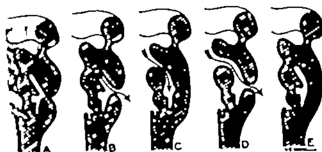


Fig 42. Series of diagrams to show how several kinds of tracts and cysts may arise through faulty development of the pharyngeal wall.
A. Normal pharynx showing closure of cervical sinus.
B Incomplete closure of cervical sinus forming the basis for a tract opening externally upon the surface of the neck.
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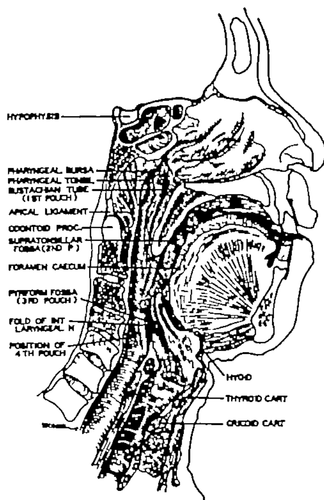


Fig. 43 Hemisection of the adult head and neck showing the positions which correspond to the sites of the original pharyngeal pouches I–IV (From a specimen)

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arch rostrally, an occipital fold caudally and an epipericardial fold ventrally (Fig 44 A) In the succeeding two weeks, the margins encroach upon the field covering the fourth arch, leaving only the flattened surface of the third arch exposed caudal to the hyoid margin (Fig 44 B C) According to Frazer (1932) an expansion of this exposed area covers the anterior triangle of the neck Later this cervical field has the sternocleidomastoid muscle as a boundary (Fig 44 D) Accordingly any persistent openings related to the cervical sinus should appear ventral to the sternocleidomastoid muscle. When these openings do occur they invariably bear the expected relationship to the muscle

Figure 45 illustrates the common sites at which persistent clefts may open Fistulous openings may occur in the neighborhood of the auricle A lower cleft opening may bear a rudimentary ear (not shown) A persistent second cleft opening may bear an auricle the normal (hyomandibular) auricle being suppressed

Between the pharyngeal openings and the surface, the relationships of branchial fistulae are rather constant they are shown schematically in Figure 46

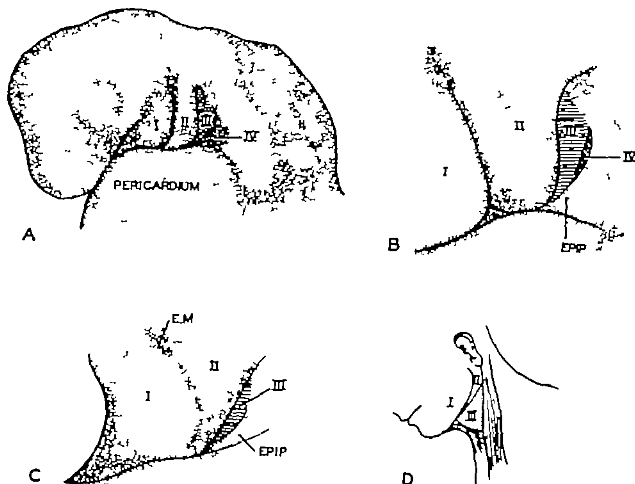


Fig 44. Head and neck regions of human embryos showing the manner in which the cervical sinus is closed
A. An embryo of 4 9 mm. (about 4 weeks) Arches III and IV are being overshadowed by the rapidly growing hyoid arch.
B View of arches and grooves in a 10 mm. embryo (about 5 weeks) The encroachment of the marginal folds narrows the opening into the depressed area the smaller fourth arch is being covered
C. Arch area in a 12 mm embryo (about 6 weeks) Further closure has left only an area of the flattened third arch exposed.
D Definitive condition after the appearance of muscles expanded third arch ectoderm covers the neck to the ventral margin of the sternocleidomastoid muscle. E M External acoustic meatus. Epip Epipericardial fold. (Based upon figures in Frazer's "A Manual of Embryology" 1932 Courtesy Williams & Wilkins Co Balto.)

Inasmuch as the vessels of the first two arches of man disappear early (sixth week), that of the third arch is the first of the series to be retained and becomes the first part of the internal carotid artery The external carotids are more ventrally placed Consequently, a fistula, stemming from the tonsillar fossa (second pouch) must pass between the carotid arteries and ventral to the vagus, taking a position lateral to both the common carotid

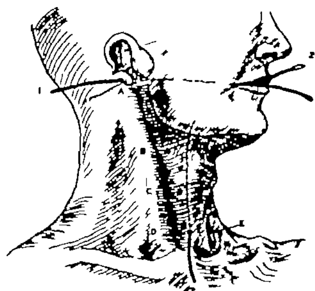


Fig 45 Drawing showing sites at which fistulous openings may appear

A. Opening of a fistula auris of the first (Hyomandibular) cleft. Sound No. 1 indicates its communication with oral cavity

B and C Possible locations of an opening of a cervical fistula originating from the position of the second pharyngeal pouch. (See Fig.42 D Fig 43 and Fig 46.)

D Opening of a fistula of third pouch origin sound No 2 has been passed through it from the mouth

E Opening of a thyroglossal duct fistula (Based upon a figure in Corning, '21)

and the nerve. A fistula of second pouch origin usually opens on the neck at, or near, the level of the larynx

A fistula arising from the third pouch (caudal to the third arch) must emerge caudal to the hyoid bone (Figs. 44 and 46) and to the artery of the third arch the internal carotid It is therefore related to the common carotid (or perhaps the lower end of the internal carotid) The fistula as it passes laterally crosses dorsal to the artery ventral to the vagus, and then courses caudally to its termination

The writer is not aware of any reports of epithelial tracts extending from the fourth pouch to the cervical sinus or surface of the neck. Theoretically, at least such a fistula could occur and, if formed, would be dragged caudally as a loop by the aortic arch on the left and by the subclavian artery on the right. According to Frazer (1923), the course taken

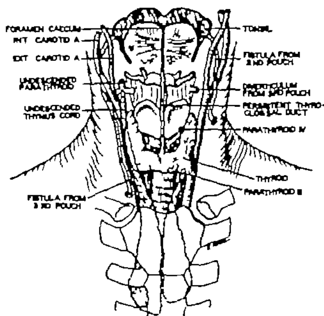


Fig 46. Schematic diagram in which is collected a number of anomalous conditions resulting from the faulty development of the cervical sinus pharynx, and glandular derivatives of the pharyngeal epithelium. On the subject's right Note undescended parathyroid III residual thymus cord and a branchial fistula from pharyngeal pouch III A previous connection of the fistula with a diverticulum of the supratonsillar fossa is broken Center Persistent thyroglossal duct passing ventral to (or through) the hyoid bone. On the subject's left Note a diverticulum of pouch III an incompletely descended thymus still attached to parathyroid III, and a fistula of second pouch origin (Adapted from various sources chiefly Braus, '34 Fig 66)

by a fistula of the fourth pouch would militate against its survival in any dangerous form

The relationships of these fistulous tracts as enumerated are not merely theories but facts, and are absolutely fixed That is, if a duct is found to pass behind the common carotid and ventral to the vagus, it is associated with the third pouch but if it has other relationships, it is not If the fistula passes between the internal and external carotids, it is of second pouch origin Frazer (1923) states that a de

parture from this plan is not possible, if the vessels are normal

These defects of cervical sinus or pharyngeal pouch origin may not be as extensive as de scribed above. The tract may be broken some where along its course (Fig 46), or else lose its terminal connections and persist only as a closed, elongated pocket, or as a cyst (Fig 42) In any case the persistent segment, depending upon its level in the neck may be expected to have the customary relationships outlined above. This point is confirmed by the observa tions of Bailey (1923) in clinical cases of bran chial cysts.[11]

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[11] See comments of Frazer (1923) upon the article by H. Bailey (1923) on branchial cysts.

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Chabtei III

BENIGN TUMORS AND PREMALIGNANT LESIONS OF THE SKIN OF THE HEAD AND NECK

In a recent review of the histories of 840 skin malignancies it was astounding to note how poorly managed a substantial percentage of them had been prior to admission to our clinics. Several factors combine to produce this serious situation On the one hand the patient frequently does not give much cognizance to small innocent-appearing lesions until they have developed into frank malignancies with local and/or distant metastases. On the other hand the first physician must share the blame if he renders inadequate treatment due, per haps to his lack of knowledge It cannot be over-emphasized that adequate therapy to small tumors is the best way to cure large ones Complete eradication of tiny lesions is more important than endeavoring to produce a perfect cosmetic result by insufficient treatment The oncologist is consulted by patients with a history of having had small or insignificant appearing neoplasms treated over a period of *months to years with modalities such as salves*, ointment acids caustics, the electric needle, or insufficient irradiation (x ray or radium) until there is a large malignant ulcer with local and distant metastasis.

Each lesion should be individualized and the therapy chosen which will eradicate it at the first treatment or first series of treatments. This in the end will give the best cosmetic results.

Biopsy

For accurate diagnosis and proper treatment it is necessary that adequate material taken from a typical part of the neoplasm be submitted for histological study as vital to efficient treatment of tumors as x ray examination is in the intelligent handling of fractures It may not appear worthwhile that every small or insignificant wart or mole removed be submitted for pathological study but if growth potentialities or premalignant tendencies are present an opinion from the pathologist should be obtained Frequently the entire tumor when small is removed with the biopsy forceps, provided the base is immediately destroyed with electrodesiccation It should be remembered that the pathologist can pass only on the specimen submitted to him therefore he must receive a sufficient amount of typical tissue The base *or edge of the ulcer or tumor where* disease invades normal structures is the best site for biopsy Infected or sloughing areas are to be avoided

The question frequently is raised whether biopsy may aid the spread of the lesion in the event it is malignant The information obtained far outweighs any ill effects that may accrue from obtaining material for examination

BENIGN MOLES

The nevus or mole is essentially a neoplasm containing nevus cells that may or may not produce a specific pigment melanin. This group of tumors forms one of the most interesting topics of oncology They may be localized or generalized pigmented or non-pigmented *single or multiple* unilateral or bilateral flat raised or verrucoid. The origin of the benign mole has been controversial for the past half century The first theory advocated was that they are of epithelial origin Later as spindle cells were noted in some of them suggesting relation to connective tissue these tumors were placed in the classification of sarcomas. The latest and perhaps most interesting theory is

their possible neuroblastic origin. Whether of epithelial, connective tissue, or neuroblastic origin it is evident that they are derivatives of embryonal cells and remain biological 'out laws' throughout life.

The connective tissue surrounding the nevus cells never attains the full development of connective tissue in other parts of the body. Perhaps the same factors that give origin to the nevus cells or permit them to grow in some cases with such great rapidity also affects the development of the adjacent connective tissue. This important fact that the surrounding connective tissue never attains full development is, of itself, sufficient evidence that these areas are always a potential source of tumor formation.

Metastases from malignant melanomas do not follow the same pattern as from other tumors. While epithelial neoplasms spread through the lymph vessels, sarcomas or connective tissue tumors usually metastasize through the blood vessels, but the melanomas may metastasize either by way of the lymphatics or blood vessels. The more violent malignant alveoli forming tumors metastasize via blood vessels, whereas the fibrotic or slower growing spindle cell type of melanoma usually disseminates by way of lymph vessels.

ETIOLOGY

The nevus or pigment cells never form a characteristic arrangement. They may be found singly or in clumps, strands, nests or heaps. The connective tissue around them may be rather sparse and thin allowing a profuse growth of nevus cells, or there may be an abundance of connective tissue with only thin strands or small nests of nevus cells. The dark pigment, melanin, is found in the form of granules within the nevus cells except when malignancy develops. It may then be outside the cells.

Diverse theories have been offered as to the origin of the nevus cells. Israel and Lubarsch are of the opinion that they arise from undifferentiated connective tissue cells. Von Recklinghausen theorized that they had their origin in the endothelium of the lymphatics. The most widely accepted theory for a long period of time was that of Unna, who advocated that they were of epidermal origin. It was his opinion that the nevus cell springs from the basal cell by a process of gradual differentiation and that these differentiated cells migrated into the corium by means of a drafting process. Rippert advocated the theory that the chromatophores of the cutis are the parent cell of the nevus cell. Masson has revived Soldan's theory that they were neuroblastic in origin.

CLINICAL FEATURES

Affleck has shown that benign as well as malignant, melanomas occur more frequently on the exposed surfaces of the body which may



Fig. 47. Benign nevus, nasolabial fold. The nevoid cells contain very little or no pigment. Treatment may be thorough electrodesiccation or surgical excision.

be explained by the solar stimulation of the melanoblast resulting in an increased pigment production in the benign nevi at these sites. Our observation as well as others has shown that 40 per cent of the benign nevi occur on the scalp, face, and neck, and the majority are congenital in origin. Pigmented nevi are seldom seen in the Negro. This is in keeping with our observation that malignant lesions of the skin, face, neck, and lips are infre—

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Fig. 47 Benign nevus, nasolabial fold The nevoid cells contain very little or no pigment Treatment may be thorough electrodesiccation or surgical excision

be explained by the solar stimulation of the melanoblast resulting in an increased pigment production in the benign nevi at these sites Our observation, as well as others has shown that 40 per cent of the benign nevi occur on the scalp, face, and neck and the majority are congenital in origin Pigmented nevi are seldom seen in the Negro This is in keeping with our observation that malignant lesions of the skin face neck, and lips are infrequently en

countered in the negro race perhaps due to the increased pigmentation. The degree of pigmentation of the nevi varies remarkably from light brown yellow, and blue to black Bloodgood (quoted by Affleck) stressed the fact that the raised type of nevus was potentially more malignant and should be removed more frequently than the flat type because they are more readily subjected to trauma However which the cells may be pale-staining or rather deeply staining and limited to the dermis. This type is potentially malignant In the third group there is an increase in the number of melanoblasts at the epidermo-dermal junction It is in the truly pigmented or second type where the cells are confined to the corium in which there may be some doubt on histological examination whether the lesion is either benign



Fig. 48

A Pigmented nevus just below inner canthus of left eye Lesion benign at this stage but potentially malignant Surgical excision advocated.
B Photomicrograph showing pale-staining nevoid cells infiltrating the subcutaneous tissue

we have seen several light brown smooth moles on the scalp and soles of the feet metastasize widely and rapidly probably because of constant trauma The pigmented type which frequently have coarse hair arising from their surfaces are according to most observers less likely to become malignant

There are three types of moles occurring in the skin one in which nevoid cells are found with little or no pigment This type is usually benign (Fig. 4) The second is generally referred to as the true pigmented nevus in or malignant In the third group the nevus cells are not confined to the corium but may infiltrate the connective tissue beneath the dermis and extend into subcutaneous tissue (Fig 48 A B) In this group the nevus cells usually have prominent nuclei and may resemble lymphatic cells. They may occur in bundles or separately or in small islands surrounded by connective tissue The melanin pigment may be intracellular or extracellular

The average individual according to most observers has at least twenty nevi scattered

over the body Such lesions are usually more or less permanent and seldom develop malignant changes. Multiple moles are less likely to become malignant than solitary ones, but any change in one of many moles is almost proof of malignancy in the altered mole



Fig 49

A. Papillary benign pigmented nevus present since childhood Began to grow six months ago. Removal imperative because it is irritated by shaving

B Columns and strands of nevoid cells, some with rather dark nuclei indicative of premalignant stage



Fig. 50

A Papillary nevus of the scalp. This type of nevus should be removed because chronic irritation from combing hair may stimulate it to develop malignant changes.

B Nevus removed with electrosurgery

It has been shown by Pack that congenital moles have their greatest rate of growth at the age of puberty and may then become malignant without trauma.

As life goes on, repeated trauma or irritation stimulates growth (Fig 49 A, B) Cellular ac

tivity is characterized by increase in height and size, or perhaps deeper pigmentation bleeding, and ulceration and a halo of irritation around the edge of the lesion When this stage is reached malignancy may have already started and microscopic metastases occurred, treatment therefore may be too late to assure a cure It is important then to remove before puberty all large and dark moles, especially where irritation may be present Also in adults, remove any mole that is on the scalp or sole



Fig 51 Pigmented nevus left side of nose Irritated when drying his face This type of nevus is slow growing and when it becomes malignant slow in developing metastases

of the foot or any other part where irritation is unavoidable before signs of change in character begin (Fig 50 A B)

SOLITARY MOLES

A solitary or single mole is frequent and may be bluish black in color The color is attributed to the location of the dark or black pigment in deep layers of the corium giving the bluish hue as the color passes through the opaque skin These lesions are as a rule raised and firm in consistency It is well to consider all solitary pigmented nevi as premalignant and they should be dealt with as such The temple shoulders, scalp face and the area around the eyes are the most common sites. These lesions are observed early as they are situated most frequently on the exposed parts of the body and consequently readily subjected to trauma (Fig 51) A solitary type of the blue-black mole or nevus may grow to the size of a small lemon. The top of such large lesions frequently becomes ulcerated and discharges inky fluid. Clinically when these lesions do become malignant their growth is slow metastasis is slow in developing and histologically they have more the appearance of connective tissue than of epithelial origin Single benign moles should be removed because of the possibility of their



Fig 52 Small pigmented nevus, external canthus, right eye safely removed with thorough electrodesiccation and minimum of scarring.

changing into malignancy and for cosmetic reasons.

TREATMENT

Benign moles should be removed either by electrosurgery or surgical excision In the past electrosurgery has been criticised because of poor results and metastasis after inadequate treatment After all many moles have metastasized prior to surgical removal or during or after incomplete scalpel removal The important thing is the thoroughness of the method and the time of treatment

Benign lesions under one centimeter in diameter are safely removed by electrodesiccation The technic is as follows

An area circumferentially around the mole one centimeter or more in width is anesthetized

with 1 per cent procaine solution The tissue beneath is then infiltrated The needle electrodesiccator is pushed through the normal skin close around the lesion, the needle extending through the entire depth of the skin As the skin adjacent is blanched the needle is moved from place to place until the entire mole is circumvallated The blood and lymph drainage from the sides is thereby cut off and the main body of the mole is then destroyed by piercing throughout with the needle Great care is exercised to assure that the needle passes through all layers of the skin into the subcutaneous tissue, thoroughly destroying all nevus cells Gentian violet (2 per cent solution in 50 per cent alcohol and 10 per cent acetone) is placed on the wound forming a protective scab As the wound heals beneath the scab there is a slow contraction of the tissues, a very small scar resulting (Fig 52) Occasionally slight infection develops beneath the scab requiring removal and appropriate antiseptic dressings

Benign moles larger than 1 cm in diameter require surgical excision (Fig 53) Small lesions are excised under procaine anesthesia, and large ones may require sodium pentothal anesthesia A wide margin should be given on all sides of the lesion, including a safe margin of fat beneath to completely remove the tumor The edges of the wound are undermined, when necessary for ease of approximation The subcutaneous tissue is sutured with interrupted white silk, which should hold the wound together without tension the knots of these sutures are inverted The skin is then closed with a fine needle carrying black silk Following this plan there should be little scarring



Fig. 53 Non-pigmented nevus, right temple irritated by brushing her hair has developed a dark rim around it in a premalignant stage. Such lesions should be surgically excised with an adequate margin around them.

The use of escharotics careless electrodesiccation, or x ray has no place in the treatment of either benign or malignant moles or melanoma

ments as it is frequently seen on the face neck hands and arms of farmers sailors and people who work in the out-of-doors In other words it is found in areas that are uncovered



Fig 54

A Multiple hyperkeratoses over the cheeks and forehead one keratotic area measures 2 cm in diameter Such areas frequently undergo malignant transformation.
B Lesion destroyed with electrodesiccation after biopsy
C. Photomicrograph showing hyperplasia of the stratum corneum with round cell infiltration

HYPERKERATOSIS

Hyperkeratosis of the skin may occur spontaneously or be associated with senile atrophy of senile keratoses, so that they may be considered a part of the same syndrome This condition is more frequently encountered in older individuals However it m t age in people who are expos

by clothing Individual lesions may develop which may remain solitary but more frequently numerous ones are present (Fig 54 A B C) Hyperkeratotic areas vary from pin point size or 2 cm in diameter As a rule they begi ll-circumscribed scaly area that vari from dark gray to dark brown and lmost black in color

HISTOLOGY

The stratum corneum shows marked thickness There may be hyperkeratotic cones that project deeply into the cutis which frequently extend to the level of the sweat glands and hair follicles. The hyperkeratotic area stains lightly, whereas, the cells of the projecting cones stain more deeply Occasionally giant cells are noted Various types of atypical epithelial tags, strands and buds may project from the basal cell layer into the cutis There are varying degrees of infiltration with small round and plasma cells, more pronounced when malignant transformation takes place

CLINICAL FEATURES

It is estimated that about 15 per cent of the hyperkeratotic or senile keratotic areas undergo malignant transformation into either basal or squamous cell carcinoma Basal call carcinoma develops more frequently than the squamous cell carcinoma. When malignancy takes place the keratotic area becomes inflamed around the edges and the base becomes thickened or indurated the patient may note a stinging or itching sensation Telangiectasis is also frequently present (Fig 55 A B)

TREATMENT

Early diagnosis with proper treatment of all hyperkeratoses or senile keratoses of the face, neck and hands is essential for cure (Fig 56 A B) The lesion can be destroyed either by irradiation or electrodesiccation If the former is used it should be limited to areas under 2 cm in diameter The scarring from both methods of treatment is about the same

Electrodesiccation to be thorough requires the injection of 1% procaine solution around the border and in the tissue beneath. The lesion is then gently sprayed with the spark of an electrodesiccator the point of the needle coming in contact with the surface and moved from place to place until all has been dehydrated The dehydrated top is brushed off and the lesion is again gone over without the needle coming in contact with the skin No attempt is made to injure the dermis, preventing undesirable scarring The treatment of these benign keratoses is limited to the epidermis. Two per cent gentian violet in 10 per cent acetone and 50 per cent alcohol is applied to form a



Fig 55

A. Keratotic areas over right forehead and right side of nose. Lesion on right side of nose has been irritated around the border by spectacles. This represents a premalignant manifestation

B Photomicrograph shows the hyperkeratotic layer staining slightly downgrowth of epithelial pegs some round cell infiltration.

sterile protecting scab Healing occurs in two to three weeks.

Irradiation therapy may be given by roentgen or radium rays. We prefer roentgen therapy, using 1500–2000 r, unfiltered (140 Kv),

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either in one or two sittings (two sittings should be spaced at five day intervals) A well marked erythema and bronzing follows with scaling off and healing in from three to four weeks If there is any evidence of malignancy (thickening or induration) adequate biopsy must be taken before any type of therapy is instituted

Vitamin A in doses of 100 000 units daily for several months has been suggested (Leitner

ETIOLOGY

The etiology of seborrheic keratoses has not been proved It is thought by some that they are produced by a change in the secretion of the sweat glands whereas, others contend they belong to the nevoid group of skin diseases. Most investigators hold that the lesions remain benign However Hartzell McKee and Mac Carthy believe that they frequently undergo

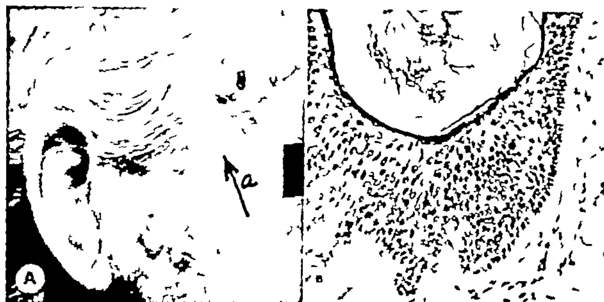


Fig. 56

A Keratotic patches over right cheek and temple. Such areas frequently develop an erysipeloid type of reaction One area previously treated with 2000 r x-ray A second area is developing suggestive of basal cell changes.
B Photomicrograph shows desquamated epithelium which stained poorly Downgrowth of epithelial pegs. Round cell infiltration.

and Moore, and Dublin and Hazen) but we have had little experience with its use.

SEBORRHEIC KERATOSIS

Seborrheic or papillary keratoses of the skin are circumscribed elevations, varying in size from the head of a match to 1 or 2 cm. in diameter The lesions are usually multiple and are more frequently noted in individuals with greasy skin and are more commonly seen on the face neck nose around the external auditory canal and behind the ears. Their color varies from brownish to a grayish-black Small spots may be present which correspond to the openings of the sweat glands (Fig 57 A)

malignant transformation Vitamin A deficiency may play some role in the development of senile and seborrheic keratoses, as suggested by Dublin and Hazen.

HISTOLOGY

Histologically the seborrheic keratoses can readily be differentiated from senile keratoses. As a rule there is marked hyperkeratosis of the horny layer at times reaching the point that will simulate cutaneous horns Some areas have dilated sweat glands containing horny casts The cones of the epithelial cells may project downward into the connective tissue and on tangential section appear like islands re

sembling carcinoma. There is frequently infiltration of lymphocytes and plasma cells, especially noted around the hair follicles (Fig. 57 B)

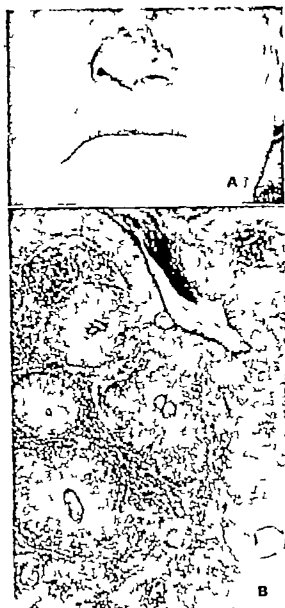


Fig 57

A. Seborrheic keratoses of the nose.
B Photomicrograph showing hyperplasia of epithelial pegs. Downgrowth of epithelium Dilated sweat gland containing horny casts. Round cell infiltration Such lesions are definitely premalignant.

TREATMENT

Seborrheic keratoses are treated in the same manner as hyperkeratoses previously described

VERRUCA AND SENILE WARTS

This group of tumors occurs at all ages but those in older patients are more apt to become malignant. These epithelial growths are com-



Fig 58 Elevated wart. Rapid growth past few months Treatment surgical excision.



Fig 59 Papillary verruca scalp Irritated if patient combs or brushes her hair

monly situated on the face (Fig 58) neck and hands. Those on the temple, face or dorsal surface of the hands are of more clinical impor-

tance because of the frequent degeneration into malignant tumors especially the squamous cell variety These lesions usually begin as flat keratotic patches, which gradually become elevated and may be diffuse or circumscribed (Fig 59) The flat, brownish lesions that are



Fig. 60. Papillomatous verruca, left side of nose A. Dark brownish in color simulating a melanoma. B Photomicrograph downgrowth of epithelial pegs round cell infiltration Evidence of premalignant changes.

elevated are sometimes confused with melanomas on account of their dark color However when examined histologically they are shown to be of epithelial origin.

HISTOLOGY

These warts are confined to the epidermis and are made up of dense epithelial papillations of varying height Unless the precancerous stage has begun, the dermal connective tissue remains unchanged However when malignancy ensues the first signal is an invasion of the dermal layer with the proliferating epithelium and infiltration of round cells. Lesions of long standing (Fig 60 A, B) may exhibit rather marked cellular proliferation and subdermal masses of epithelial cells.

CLINICAL FEATURES

Warts in young children are usually of a virus origin and commonly multiple on hands, feet,



Fig 61 Pigmented verruca, left temple began several years ago as a small light brown patch over left temple During the past year has gradually increased in size and increased markedly in color Biopsy squamous papilloma

and face They appear as varying sized, hard, villous tumors some disappear spontaneously

In older patients verruca are more often single and appear on the lips, skin of the face and neck and in the nostrils, especially on the sides of the columella.

Senile warts are large, flat or papillomatous growing slowly and gradually becoming darker often being mistaken for pigmented nevi (Fig 61) The surface is rough and irregular due to the finger like projections of hypertrophied squamous epithelium. Often these tiny projections can be broken off

REATMENT

These lesions are destroyed either by electrodesiccation or by x ray Electrodesiccation requires local anesthesia The skin around and beneath the wart is injected with 1% novocain The electrodesiccator is thrust into the skin at the edge and the needle remains until the adjacent tissue is blanched It is then removed from place to place until the wart is circumvallated The wart itself is then attacked and entirely dehydrated The destroyed tissue is removed with a curette down to the soft growing center which is again dehydrated with the needle electrodesiccator Two per cent gentian violet solution (page 18) is applied Healing will be slow and there will be gradual contraction of tissues around the destroyed area with very little scarring The lesion can be destroyed with equal facility by irradiation Usually 1500–2000 r given through a suitable cone in one or two sittings, will effect a cure. Treatment factors 140 Kv 15 Ma, no filter skin target distance 35 cm

TUMORS OF THE BLOOD AND LYMPH VESSELS

Hemangiomas

Hemangiomas are common tumors of the skin of the face and neck, especially in infants and young children Lymphangiomas are uncommon Most hemangiomas will disappear spontaneously after a few years but are treated in early life for cosmetic reasons and to prevent infection and secondary hemorrhage which is especially liable to occur when the hemangioma is located about the mouth or nose where trauma is common

It is frequently difficult to classify separately the arterial and venous group on one hand and the lymph group on the other as often both elements are present simultaneously A satisfactory clinical and pathological classification seems a bit difficult Most pathologists follow Boyd (1942) giving two main types capillary hemangioma and cavernous hemangioma

Under the term *capillary hemangioma* Boyd put port wine stains, birthmarks and strawberry marks, the latter are elevated Under the term *cavernous hemangioma*, he places that group made up of structures similar to erectile tissue and resembles a fine sponge

Hertzler on the other hand, gives three types of hemangioma (1) capillary angioma (2) venous angioma and (3) cavernous angioma The capillary angiomas are described as intradermal capillary varicosities represented by port wine birthmarks The venous aneurysms (Hertzler also calls *arteriovenous hemangiomas*) are represented by the common birthmark or so-called *strawberry type* These are reddish in color elevated circumscribed and blanch on pressure They are also compressible on pressure The cavernous angiomas differ from the preceding in that the blood containing spaces are larger and more irregular and lack the definiteness of fully formed blood vessels

All of these tumors are either present at birth or appear soon after usually within the first couple of weeks of life They grow rather rapidly for the first few months and then become stationary The venous type or strawberry birthmark is reported by many authors to disappear after the child becomes four or five years of age The port wine stains do not disappear The cavernous hemangiomas are less likely to disappear because of their wide open blood vessels, some of the larger ones remaining throughout life, unless surgically removed Frequently it is difficult to determine whether these hemangiomas are true neoplasms or merely dilatation of previously existing vessels. It would seem that in many of the cavernous hemangiomas the latter is the case. Blood vessels elongate and therefore become quite tortuous. On removing the angioma several tributary vessels are present which when tied and cut permit the rest of the tumor mass to collapse from the loss of blood Often both arteries and veins act as tributaries.

From a clinical point of view we shall discuss these tumors in three groups capillary venous, and cavernous using the word

capillary to designate port wine stains, and *venous* to designate the usual strawberry type which is elevated compressible, and bluish red to red in color and *cavernous* for hemangiomas with large spaces that lack the definite form of matured blood vessels.



Fig 62. Port wine stain hemangioma, involving part of the neck and extending onto the cheek. They are flat, purplish-red in color may involve large areas of the face and neck. They may or may not blanch on pressure

CAPILLARY HEMANGIOMAS

Capillary hemangiomas are of congenital origin and may vary from pinpoint to areas of large size as shown in Figure 62 These are intradermal capillary varicosities, their chief interest being of cosmetic importance. Occasionally they may be associated with deeper types of vascular disease when there will be elevation palpable above the surrounding skin In this group are placed the port wine stains which are flat and purplish red in color These stains may involve as much as one entire side of the face Some of these port wine stains blanch on pressure others do not The lack of blanching on pressure is due to the presence of a reddish pigment in the skin. Microscopically these tumors show only dilated cutaneous capillaries lined with endothelium. We have seen some cases in which the capillaries were intraepidermal, as well as intradermal. There is absence of perivascular cells which are usually present in the vascular nevi.

VENOUS HEMANGIOMAS

This type of hemangioma (arteriovenous hemangiomas of Hertzler) is represented by the common, elevated tumors, as a rule present at birth or appearing soon after They enlarge as the child grows or occasionally develop more rapidly than the child during the first few months of life (Fig 63 A, B) The rapidity of growth is an important factor in determining when the treatment should be given If the growth is more rapid than the child and the tumor is becoming large and

bulky and liable to ulceration and infection from the thinned out skin being traumatized, then treatment should be given early On the other hand if the growth of the tumor is about in the same proportion to that of the child, one can wait until the child is four or six months old before treatment As a general rule, however, the earlier the treatment the better the results A few hemangiomas do not make their appearance until some months after birth or even years later The size varies from pinpoint to 5 to 7 cm in diameter and the shape from ovoid to all types of irregular forms They are as a rule covered with more or less normal skin and are more deeply seated than the capillary type Frequently the skin covering them is smooth and white, having very little turgor Large lesions may pulsate at their edges in the tributary arteries All of these dilated vessels have communication with the venous system which in fact, makes them arteriovenous aneurysms Frequently when a tumor increases in size the overlying skin becomes thin and spontaneous rupture may occur resulting in extensive hemorrhages If injudicious escharotic pastes are used the skin may become ulcerated, with the production of severe hemorrhage These tumors are soft and compressible. At times, following slight trauma or spontaneously, fibrous tissue develops producing an obliteration of the smaller vessels, beginning especially in the center and progressing peripherally The lumen of these vessels is often narrow with marked increase in surrounding connective tissue histologically simulating sarcoma. It is thought by some that this type of hemangioma bears a close relationship to the melanoma group more than blood vessel tumors. However when malignancy does ensue, it is the presence of the nevus cells that produces the mischief, even though they are few in number

CAVERNOUS HEMANGIOMAS

In cavernous hemangiomas there are large spaces that lack the definite form of matured blood vessels there may be intercommunicating cavities connected to a blood vessel, such cavities generally have an endothelial lined wall and are filled with blood In some tumors they represent lymph cysts. The skin covering them may be normal or may have a



Fig 63

A. Hemangioma over left eyebrow elevated dark red in color blanches on pressure.

B Photomicrograph shows dilated sinuses lined with single layer of endothelium some containing blood cells small amount of connective tissue stroma Treatment of this type of hemangioma is successful with radium, surgical excision, or injection of sclerosing solutions.

bluish hue from the large venous channels lying beneath Some cavernous hemangiomas are combined with capillary or venous hemangiomas in the overlying skin giving a purplish red color (Fig 65 A and B) They as a rule, remain stationary but following slight

trauma the vessel wall becomes irritated with resulting perivascular connective tissue reaction producing pain (Hertzler) If the trauma is severe the skin may be damaged causing ulceration and hemorrhage Following



Fig 64 Hemangioma on vertex of skull since birth

A Following trauma the center has blanched Best treated by radium

B Lumen of vessels obliterated with increased connective tissue

repeated trauma and infection and fibrosis the entire tumor may be obliterated with scar tissue

CLINICAL FEATURES

Three fourths of our hemangiomas were present at birth the most common sites being in the skin of the head and neck In a series of cases from the University of Maryland Oncology Department Ward and Covington found the distribution as follows the face, 28% scalp 11%, eyelid, 2.3% buccal mucosa



Fig 65 Cavernous hemangioma

A Tumor present since birth gradually increasing in size Skin thin over summit of hemangioma.

B Photomicrograph shows large dilated vessels filled with blood cells connective tissue sparse

8% neck 10% and the remainder on body and extremities The port wine stains were all present at birth The most common site of the port wine stain type of hemangioma is the nape of the neck it is estimated that 33 per cent of all new born babies of the white race have this type of lesion

In about 55 per cent of the patients the hemangiomas were single in 45 per cent there were two or more Frequent association of superficial hemangioma with hemangioma of some internal organ has been reported, i e, hemangioma of the face or scalp with hemangioma of the brain The port wine stains usually remain about the same in intensity of color as noticed at birth except they enlarge as the child grows In this series about 90 per cent of the hemangiomas were noted in the white race, 10 per cent were in the negro race Females are more frequently involved than males about two to one relationship It seems that in this series blondes also have the edge over brunettes.



Fig 66

A. Extensive hemangioma involving the right temple eyelids, cheeks, and lips. Treated with radium over a period of several months. One area would be treated at a time

B Result shows some scarring which will tend to improve as the child grows older

TREATMENT

The more common forms of treatment are radiation electrosurgery surgery dry ice injection with sclerosing solutions, tattooing and covermark These will be discussed in the order of importance, as used in our clinics

The time of treatment of a hemangioma will depend on several factors namely, the location of the lesion the rapidity of growth the type of hemangioma and the age of the patient Hemangiomas about the mouth and genitalia or hips, subject to injury and infection require prompt treatment Those on the face (except about the mouth) need be treated only for cosmetic reasons, treatment may be withheld until four to eight months of age Hemangiomas growing more rapidly than the child are apt to distend the skin to such thinness that ulceration infection hemorrhage, and subsequent scarring and disfigurement results (Fig 66 A and B) These birth marks require prompt treatment If the hemangioma is growing at the same rate as the baby it is probably better to wait until the child is at least two to four months of age before treatment Port wine stains and cavernous hemangiomas not radiosensitive may wait for operation until the child is four to five years old If the treatment is irradiation or dry ice the earlier instituted the better the results for the following reasons (1) The endothelial cells lining the vascular space of the tumor are more radiosensitive during early life while they are in their embryonic stage The radiosensitivity of these cells decreases in direct proportion to age Consequently good results from radiation

decrease in the same proportion (2) In the event the tumor is growing early treatment will prevent it from becoming larger and spreading (3) The residual effects of radiation—increased pigmentation and scarring—decrease as time passes, so that the younger the child, the longer the t me for these effects to disappear

Irradiation. This may be given either by radium or x ray, however due to the fact that it is almost impossible to keep a baby necessarily quiet under an x ray apparatus one to two hours and the dose is from 180-400 mg hours, depending on the size of the tumor Our average dose is two threshold erythemas at 0.5 cm. distance Radium plaques may be made any size or shape to fit the tumor permitting the irradiation to be equally distributed The smaller and more sensitive growths may respond satisfactorily to one application of radium others require a second or more rarely a third spaced at three to four months. It is emphasized to the parents at the time of initial treatment that



Fig. 67

A Hemangioma left lip ala left side of nose. Treated with radium (200 mg hr) over each lesion. Two treatments were required.
B Good cosmetic result following treatment.

radium has been more frequently used (Fig 67 A and B) All of these cases are screened by a staff equally competent to use all the modalities, irradiation surgery or electrosurgery so an unbiased opinion governs the therapy Radium was used in 74 per cent roentgen therapy, combined or alone, in 10 per cent of the cases The technic of radium therapy is as follows The amount of radium usually varies between 75 and 200 mg of element the filter is 1 mm of platinum screened with monel metal and felt The distance is 0.5 cm The time will vary from one to three treatments may be required Large hemangiomas are treated piecemeal by marking the tumor into segments, and treating one area at a time care being exercised not to overlap and cause irritation A progressive fading follows for from two to six months. The parents must be kept mindful of the advantages of this slowness of regression The number of treatments should be as few as possible that will produce the optimal results with a minimum of sclerosis and pigmentation of the skin—the residual effects of over irradiation Never repeat the treat

ment until the regression from the previous application has ceased. Too rapid and intensive therapy produces undesirable scarring and often late necrosis. Infants require fewer treatments than older children Irradiation is seldom of value in the treatment of hemangioma in adults. In this series one treatment was sufficient in 31.5 per cent whereas, two or more treatments were necessary in the remainder In a small number with patches of residual hemangioma or telangiectases, dry ice (solid carbon dioxide) sufficed to complete the eradication

Radiation with beta rays from radium is especially valuable for treatment of superficial capillary hemangiomas (except port wine stains) about the eyes and face Beta rays penetrate only slightly and damage to the eye is avoided.

Capillary hemangiomas in certain sites i e cheek scalp and neck (Fig 68 A, B) are equally well treated with radium or surgical removal There are many tumors situated about the mouth eye or ear where surgical removal is difficult or possible only with extensive plastic procedures. These tumors are preferably treated by radium because excellent results are obtained and long operations on infants are avoided also ulcerations and hemorrhage from trauma which may occur while awaiting sufficient age for operation are prevented Occasionally large hemangiomas about the lips interfere with nursing These are treated with radium early in life so that nursing may be resumed

Both roentgen and radium rays act by producing an obliterative endarteritis, diffuse sclerosis and fibrous perivascular stroma. Results of irradiation therapy of hemangiomas depend on two biological phenomena the radiosensitivity of the tumor cells and the radiosensitivity of the surrounding stroma The radiosensitivity of the endothelial cells lining the blood vessels and the supporting stroma is greater the younger the individual It is preferable, then that treatment be instituted early

Cavernous hemangiomas do not yield well to radiation as the blood channels are too large to be sclerosed Also frequently there is in these hemangiomas an associated hyperplasia of fat and connective tissue, evidenced by marked elevation and firmness of the tumors These will eventually require surgery

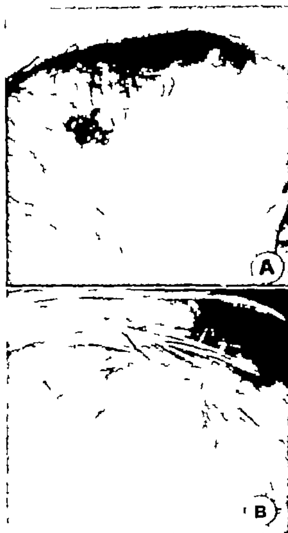


Fig 68

A. Hemangioma on right side of scalp since birth enlarged as baby grew

B Result after treatment with 210 mg hr of radium.

When however, there is a combination of capillary and cavernous elements present, a combination of radiation followed by surgery is helpful The radiation obliterates the capillary growth and makes surgery easier and less radical The cavernous hemangiomas containing an excess of fat and connective tissue form a small percentage of all hemangiomas and are seldom seen on the face and neck.

These tumors are more frequently on the trunk.

Since port wine stains are essentially fine *capillary dilatations in the skin it would* appear that they should respond satisfactorily to irradiation. Our experience, confirms that of many others that these birthmarks sometimes called *nevus vinosus* do not respond to *radiation* either by radium or roentgen therapy regardless of the age of the patient. It is possible that this resistance as compared to the ordinary venous capillary hemangioma of the strawberry elevated type, is due to their origin from more adult types of capillaries which would naturally be resistant to radiation. The treatment of port wine stains, then, resolves itself to (1) excision if the area is small and primary suture can be carried out (2) excision and skin graft if the patient or the patient's family (when the patient is a child) wish. *Since these plastic procedures are* quite extensive at times the question of their value arises. It is often difficult to obtain proper skin to match large areas on the face. (3) Many of these port wine stains can be covered with a cosmetic called *Covermark*. This preparation is made up in the form of a paste and applied with a brush daily or more frequently if indicated (4) Dry ice has been tried but is not very satisfactory (5) Tattooing with a form of permanent pigment (see below) is of benefit in selected patients.

Surgical excision is the oldest form of eradication of hemangiomas. This method is used by some practically to the exclusion of other means. As mentioned it is the method of choice in treating cavernous hemangiomas, and in treating hemangiomas that do not fade on pressure, evidence of a large amount of connective tissue and fat. It is also useful in hemangiomas in older patients or in older children or may be used in larger and resistant hemangiomas that were not completely eradicated by irradiation dry ice or sclerosing solutions. The occasional residual unsightly scar may be corrected surgically. Small lesions or small remaining scars are corrected in one stage, *the entire area being excised* and closed with or without a skin graft. It has been our experience as well as that of others, that larger lesions or residual scars are partially removed in two stages. The first procedure consists of excising the center with primary closure. The subcutaneous tissue is brought together with fine white silk, inverting the knots. The skin is then approximated without tension by fine intradermal sutures of black silk on a very fine needle. The skin sutures are removed at the end of four to seven days. Several months permit stretching of the skin so that a second surgical procedure will completely remove the remaining tumor or scar leaving only a slight line scar.

Electrosurgery Superficial electrodesiccation and occasionally interstitial electrocoagulation are useful. Twenty five per cent of our cases were treated by this manner alone or combined with irradiation therapy. Very small hemangiomas especially on the eyelids, less than ½ cm. in diameter particularly if they are elevated are easily destroyed under local anesthesia (Fig 69 and Fig 70).

Some infants are so uncooperative that it is impossible to maintain the radium plaque accurately on the lip. Hemangiomas on the lip of 1 1½ cm in size are eradicated by electrodesiccation, with or without local anesthesia. Healing is complete in three to four weeks (Fig 71).

Ulcerated hemangiomas which have bled profusely and repeatedly require prompt electrodesiccation to stop hemorrhage and destroy the growth. Healing takes place in three to four weeks, depending upon the size of the growth. If the hemangioma has been completely destroyed secondary hemorrhage is rare. Plastic repair is not often required but if necessary can be planned at a suitable time.

The technic of treating cavernous hemangioma by interstitial electrocoagulation is as follows. An area around the hemangioma 2 cm wide is blocked with local anesthesia. A fine electrosurgical needle is then inserted into the tumor and the coagulating current turned

on for approximately five seconds, or until the growth begins to look pale The needle is then withdrawn and re inserted from place to place throughout the entire tumor at equal distance—about 0.3 cm apart. If the lesion is over-electrocoagulated there will be slough with unsightly scar Perhaps surgical



Fig 69 Hemangioma lower left eyelid Easily eradicated with electrodesiccation with no disturbance of function of eyelid



Fig 70 Hemangioma on upper eyelid. Successfully treated with electrodesiccation

excision is the treatment of choice for these lesions.

Solid Carbon Dioxide (dry ice) This form of therapy has been used for several years with certain advantages. It is readily available throughout the country and almost any physician or pediatrician may use it if care is exercised The effects of solid carbon dioxide are similar biologically to those produced by irradiation namely the production of obliterative endarteritis and a mild sclerosis of the surrounding stroma It should be used only in capillary hemangiomas of less than ½ cm in diameter as such growths are difficult to treat with radium element plaque or roentgen rays without treating the surrounding tissues. Pigmentation and skin atrophy are less by this form of therapy than by irradiation Solid carbon dioxide is cut to the exact size and shape of the tumor so that the scar will not be any larger than the lesion, or it may

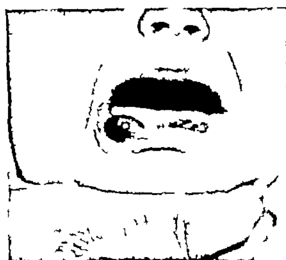


Fig 71 Hemangioma vermilion border of lower lip treated with electrodesiccation

be used in patchy growths that were previously treated by irradiation Usually the carbon dioxide snow is applied for from five to ten seconds the younger the individual the shorter the time It has been of little value in the older group of children

Solid carbon dioxide or accurately controlled electrodesiccation are indicated in small capillary hemangiomas about the eyelids, especially at the internal and external canthi where it would be almost impossible to keep the radium element plaque in position for a period sufficiently long for adequate treatment The danger of radiation to the eye is not present when using solid carbon dioxide or electrodesiccation If the lesion does not completely disappear on the first application, a second or third is repeated at intervals of

one to two months until the desired effect is obtained

Our experience with sclerosing solutions has been limited Andrews and Kelly, and Kaessler report its value in obliterating capillary injection of permanent pigments has been practiced by a number of observers. Conway and Docktor report excellent results. We have had no experience with this form of therapy An electromagnetic device is used

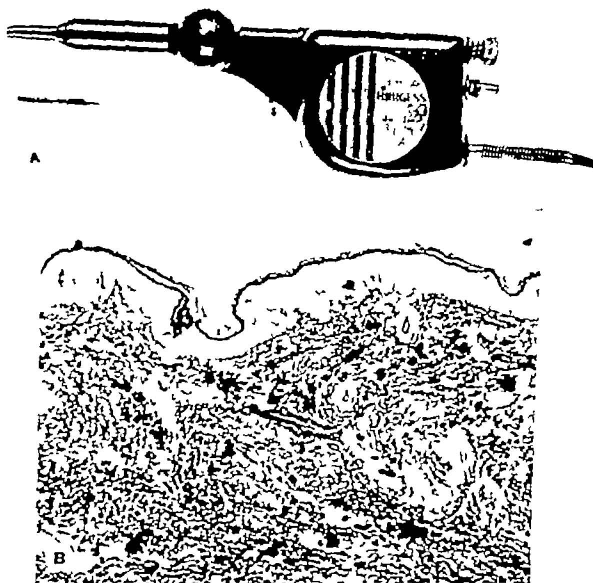


Fig. 72

A. Electromagnetic device with six needles which is used in the permanent pigment injection of capillary :mangiomas.

B Low power photomicrograph of capillary hemangioma after injection of pigment. Note that the particles of gment are deposited chiefly in the upper layers of the derma, superficial to the capillary dilatations. (Conway & octar Surg Gyn and Obs. 84 866, 1947)

emangiomas and even in small port wine ains care must be used to prevent a slough hich would result in an ugly scar perhaps quiring surgical excision and plastic repair

Neutralization of color (tattooing) in capil ry hemangiomas of the face by intradermal to inject the permanent pigment "in the derma deep to the stratum germinativum and superficial to the vascular dilatations of the capillary hemangioma Conway and Docktor found this the most advantageous method of treating port wine stains, especially when

they involve large areas of skin of the face and neck, and are not elevated above the surrounding skin A wider experience and more time will evaluate this form of therapy (Fig 72 A B)

Sturge Weber Syndrome

The association of vascular nevi of the face and occasionally the neck with homolateral changes in the cerebral cortex has been of interest to clinicians since this disorder was first described by Sturge in 1879 and later in 1922 by Weber Weber's contribution was the roentgenological features of the disease Krabbe reported the histological studies of the involved brain

Various conditions may be associated with this syndrome Frequently the patient has vascular nevi along the course of the superior and middle branches of the trigeminal nerve However, the vascular nevi may extend over the entire side of the face, neck, and scalp, and involve jaws gums, and palate. In addition, *intracranial calcification*, *pituitary dystrophy*, hemiatrophy of the brain with associated atrophy of the opposite side of the body from the angioma, paralysis, aphasia, anosmia epilepsy of the Jacksonian type and mental retardation are present in some cases. Patients may have one or more of the above symptoms

Two cases have been observed in our clinics during the past few months only one was permitted by the parents to be carefully studied and treated. A summary of the case follows.

The patient a white female 21 years of age, entered the Johns Hopkins Hospital in March of 1949 (See color plate II)

At birth a large hemangioma was present on the left side of the face which extended and enlarged to involve the entire left side of the face and scalp and reached down onto the neck. At an early age her lips became swollen with a marked overgrowth of the left side of the lower lip. There is marked hyperplasia and hypertrophy of the tongue and gums, especially on the left, due to the vascular abnormality At ten years of age, an ulceration appeared over the left temple area, giving rise to severe hemorrhage following slight trauma necessitating local resection. At two years of age convulsions affecting the right arm developed and have continued to the present, partially controlled by medication. Her mental development has been retarded.

Examination reveals an extremely large hemangioma with a purple color involving the left side of the face, ear temple and neck (Fig. 73 A–D and Plate II, D) The tissues are swollen and warm. The left side of the upper and lower lips are markedly enlarged with eversion of the lower lip The left side of the tongue is enlarged to the midline. The extreme hyperplasia and hypertrophy of the gums displaced the teeth preventing accurate occlusion. The left eye does not show any enlargement of the bulb or cornea. The fundi show no gross changes. The right hand and arm are poorly developed and are slightly smaller and softer than the left. There is little, if any difference in the lower extremities. The tendon reflexes are slightly increased on the right.

Roentgenological examination. Stereo A P and lateral views of the skull show the presence of a rather large vermiform mass of calcification in the left occipital region. This mass of calcification is traversed by serpentine-like lines of decreased density suggesting that the calcification is present in the walls of the blood vessels. The pineal gland is calcified and occupies a normal position The calvarium appears normal. The frontal and maxillary sinuses are enlarged

In the A P view there appears to be a soft tissue mass involving almost the entire left face The bones of the left side of the face appear hypertrophied so that the lower portion of the nose seems displaced to the right. The roots of the lower teeth are in relatively normal position but the crowns are angulated towards the right side, possibly due to hypertrophy of the bones and to the soft tissue mass. Some of the left facial bones appear porotic which, considering the calcification in the occipital region, indicates that there is a hemangioma involving the left side of the face and a hemangioma in the occipital region.

The findings are those as seen in Sturge Weber's syndrome.

The treatment of this case was directed toward removal of the markedly hypertrophied left upper and lower gums to improve oral hygiene and mastication. At operation the external carotid artery was ligated. The remaining upper and lower teeth on the left side which were loose were lifted out. The hypertrophied gums and adjacent, redundant buccal and lingual mucosae were excised with electrosurgical cutting current bleeding was controlled with electrocoagulation. The dissection of the redundant gum on the upper lingual side of the jaw was carried to the midline posteriorly in an endeavor to remove the hypertrophied mucous membrane of the palate A large V-shaped excision of the left side of the lower lip was done and the wound sutured in layers.

Convalescence from this procedure was normal. The

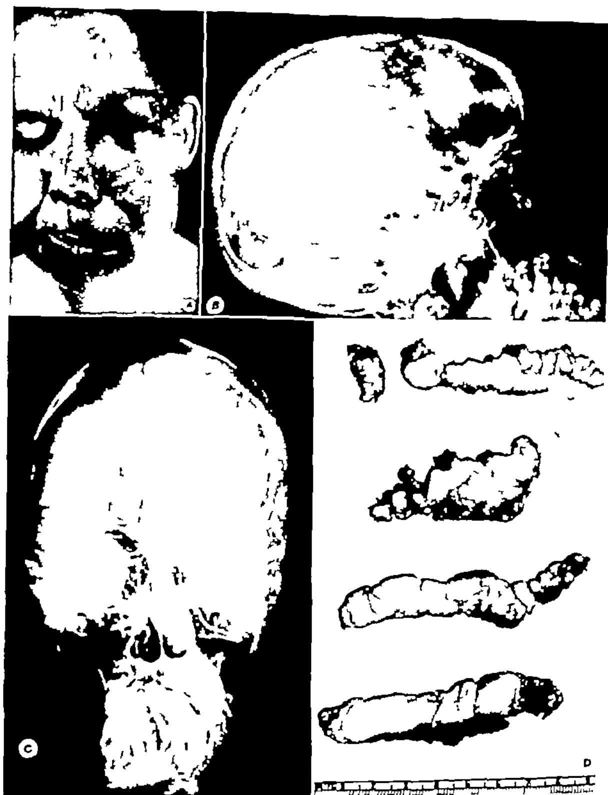


Fig 73 Sturge Weber Syndrome

A Hemangioma involving the left side of the face scalp, and neck gums soft palate and buccal mucosa in the side of the angioma with cerebral involvement

B Lateral roentgenogram of skull, showing calcification in the region of the left occipital lobe

C Anteroposterior roentgenogram of skull (note vermiform calcification)

D Gross specimen of redundant gums, mucous membrane of palate

neurosurgical department felt that they had nothing to offer for the hemangioma involving the left cerebral area.

The case is of too short duration to report the results of treatment

Lymphangiomas

Lymphangiomas are not as frequent as hemangiomas. They are anomalies of the lymph vessels comparable to those of the blood vessels Occasionally both hemangiomatous and lymphangiomatous elements occur simultaneously in the same tumor Lymphangiomas are roughly divided into capillary and cavernous types (hygromas) the former involving only the skin the latter involving the subcutaneous tissues and occasionally extending into the fascia and muscle Unlike hemangiomas they occur more commonly in older patients although occasionally they are present at birth and therefore of congenital origin They frequently occur in the face around the parotid gland and neck and also involve the lip or tongue being referred to as *macrochelia* and *macroglossia* (See Chapter VII) Clinically lymphangiomas appear as diffuse enlargements of the skin and subcutaneous tissue or mucosa and submucosa, with elevation of the surrounding tissues (Fig 74 A and B) The tumor is moderately compressible somewhat firmer than hemangioma and has a deep bluish hue. Striking reactive changes, consisting of periodic inflammation in the surrounding connective tissue with marked increase in size and density develop following trauma, often unnoticed by the patient Pain and constitutional symptoms are pronounced there may be an elevation of temperature to 103° 104 or 105 The process continues for a few days and gradually subsides, leaving increased firmness and induration. Apparently bacteria are not present the entire reaction being produced by clotting of lymph within the lymph vessels The more deeply lying lymph tumors are soft and slightly compressible and seemingly fluctuant they are often mistaken for lipomas Histologically the lymphangiomas have a simple architecture there are cystic spaces lined by flat endothelium lying on a thin connective tissue base. After several reactions there is an increase in fibrous tissue and eventually, the tumor may be completely replaced by



Fig 74

A. Lymphangioma right side upper lip since birth. Surgical excision Good results.

B Photomicrograph (high power) large spaces lined with endothelial cells. Connective tissue rather sparse in some areas. Note absence of blood cells in spaces, as seen in hemangiomas

scar leaving a firm area in the skin the only residue of the previous tumor

TREATMENT

Capillary lymphangiomas do not respond advantageously to radiation or any other

form of therapy except surgical excision (Fig 75) Complete surgical excision effects a cure, but following incomplete removal, recurrence is the rule The recurrence following incomplete removal has led some observers to believe that there was malignant transformation We have not seen any lymphangiomas become malignant. When these tumors arise in the neck either in the parotid or submaxillary regions and infiltrate under the skin in all directions they produce rather large tumors. The earlier removed the less



Fig. 75 Lymphangioma involving the entire lower lip, extending down to about half the depth of the lip. This type of lesion requires surgical excision with plastic repair the type of repair is indicated in Chapter VI on operation of the lower lip for malignancy

likely the recurrence. (See cystic hygromas, Chapt. XVII.)

Granuloma

Many children and a few adults come with tiny red elevated lesions which bleed briskly after slight trauma and alarm the mother because of hemorrhage They may be sessile or pedunculated. When these lesions occur on the skin of tiny infants, no anesthesia is necessary but in older infants and young children and adults 1 per cent novocain is injected around and beneath the tumor A ball tip electrodesiccator is pressed gently against the granuloma and the current turned on until the tissue is dehydrated down into the base. After removing the destroyed portion the base is again dehydrated. Two per cent gentian violet solution in 10% acetone and 50% alcohol forms a hard, dry, protecting scab which comes away as the area heals leaving little scarring.

Microscopic examination of these small tumors reveals a vascular structure containing much inflammatory reaction. Pathologists have difficulty in determining whether these are true hemangiomas or vascular granulations. There may or may not be a history of injury

EPITHELIAL CYSTS OF THE SKIN

Epidermoid, Sebaceous (Wens) Retention and Atheromatous Cysts

It is generally thought that this type of cyst is produced by an occlusion of the orifice of the duct of a sweat gland sebaceous (fat) gland or hair follicle Some clinicians believe that they are sacculations of the epidermis that were supposed to form fat glands, never progressed to that stage and have remained as epithelial-lined pouches The secreting epithelium is flattened by pressure of the enlarging cyst to the point where it resembles squamous epithelium (Fig 76 A and B) The cysts vary from the size of a pea to that of a small orange, are more frequently encountered on the scalp, and are often multiple. The incidence of malignant degeneration in sebaceous cysts is about five per cent (*Boyd*) Both squamous and basal cell carcinomas may have their origin in such cysts a fact calling for wide excision and careful scrutiny If the apparent cyst is found to be solid, histological examination is imperative These cysts are attached to the skin but are freely movable over the underlying connective tissue It is not uncommon to find a duct leading to the surface. Large cysts cause pressure atrophy of the overlying skin with destruction of some or all of the hair follicles giving rise to the term *bald headed cysts*

Histologically the wall of the cyst is made up of rather thick fibrous connective tissue with a lining of flattened epithelium The

contents are made up of cast-off epithelium fat and cholesterol crystals, together forming a grumous, semi-solid, cheesy or milky like possibility of malignancy taking place in the cyst (Fig 78 A and B) (3) Due to occasional firm consistency of these cysts, some





Fig 76

A Epidermoid cyst below external canthus, left eye eighteen months duration Surgically excised.
B Photomicrograph (low power) (1) Fibrous connective tissue (2) Wall of cyst (3) Cellular debris.





Fig 77

A. Sebaceous cyst, posterior surface of neck present 20 years plus.
B. Photomicrograph showing epithelial lining- contents consists of cast-off epithelium fat, and grumous or cheesy like material

material (Fig 77 A and B) These cysts require surgical removal for the following reasons (1) On account of their location they are easily traumatized and infected which frequently brings about a violent reaction of erythema swelling pain, and sometimes suppuration (2) There is a definite have been mistaken for solid tumors and treated with irradiation Inflammation and severe reaction have followed requiring surgical excision which under such circumstances is much more difficult and fraught with slower healing and greater disfigurement

Excision is carried out under the usual

local injection anesthesia After sterile preparation of the skin a sufficiently wide area is



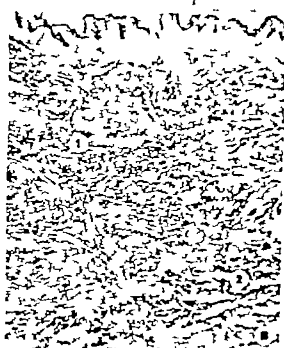


Fig 8 Sebaceous cyst scalp

A Sebaceous cyst on scalp traumatized by brushing hair A circumferential area of hyperemia developed became painful

B Photomicrograph showing cyst wall containing fibrous connective tissue At one area malignant transformation

anesthetized We prefer an elliptical incision including the area of attachment of the cyst to the skin which is usually identified by a small pore or opening of the involved gland. The cyst wall is then easily removed, preferably without rupture and the wound closed in layers with black silk interrupted sutures. Should any part of the cyst wall be allowed to remain a recurrence is probable

Small sebaceous cysts under 5 mm in diameter may be eliminated by the following method Under local anesthesia the top of



Fig 79 Dermoid cyst above right eyelid almost closing right eyelid from pressure present 15 years Surgical excision

the cysts is dehydrated by electrodesiccation The cyst is evacuated and its lining destroyed by a needle electrodesiccator inserted and passed around to all sides of the cyst The wound heals by granulation leaving a small scar

Dermoid Cysts

These cysts vary from the preceding type in that they arise in the lines of closure of various embryonic clefts and fissures and therefore are developmental anomalies (Fig 79) They may result as embryonic spilling off of the epidermal structure and gland anlages with a disturbance in the closure over the anomaly These cysts are always congenital

and may increase in size during childhood, or develop in young adult life. They occur around the internal and external canthi of the eye behind or just below the ears over the parotid areas and around the nasolabial fold Their size ranges from that of a grain of wheat to four or six centimeters in diameter Because they develop from inclusions of epidermis at the embryonic clefts and fissures they are below the skin and therefore freely movable under it, and over the underlying fascia. As a rule, dermoids have a firmer consistency than sebaceous cysts Malignant degeneration is occasionally noted but not with the frequency seen in sebaceous cysts

The cyst wall is composed of firm connective tissue and of the entire epidermis, including *hair follicles, sweat glands, and sebaceous* glands Like a sebaceous cyst they contain sebaceous material fat and cholesterin and, in addition hair arising from the hair follicles in the cyst wall Well-developed papillary projections also may be present These dermoid cysts do not have the high familial incidence and hereditary tendencies that are seen in the sebaceous cyst

TREATMENT

Here again the treatment is entirely surgical and in most instances can be carried out under usual injection of local anesthesia A linear incision is made over the cyst and the cyst wall carefully dissected out without rupture Again it is important not to leave any portion of the cyst wall behind to recur Figure 80 is that of a young girl who had a lump removed from the eyebrow on two previous occasions No histological examination was made A third operation revealed residual epithelial rests from the previous dermoid cyst If the cysts are large and have stretched the skin excess skin must be removed to give a small imperceptible scar The wound is closed in layers with interrupted black silk sutures. Here again all material removed must be carefully examined microscopically for any malignant change

FIBROUS TUMORS OF THE SKIN

Cutaneous Fibroma

Fibrous tumors of the skin are of connective tissue origin composed of varying amounts of fibrous tissue cells and fibers developing in the subcutaneous or cutaneous tissue They usually are grouped into two general classes the hard fibroma (fibroma durum) which lies within the skin is globular but may be lobulated and the soft fibroma (fibroma molle) made up of loose areolar tissue Both of these



Fig 80. Dermoid cyst in left supraorbital area, present 18 months gradually increasing in size. Surgical excision (Courtesy of A G Slvinski.)

occur singly or multiple The hard cutaneous fibroma durum is sharply defined and elastic in consistency (Fig 81) It is usually covered with normal skin unless it has been traumatized resulting in ulceration and infection They vary from ½ to 2 or 3 cm in diameter The soft fibroma is more frequently multiple, pedunculated, and may have a broad stalk (Fig 82 A and B) Frequently the soft type contains nevoid cells that are seen in amelanotic melanomas. This latter group are more common in older persons and should be regarded with much suspicion Frequently they are yellowish in color from the admixture of fatty and fibrous tissue

Supernumerary auricles are embryonic anomalies and are placed under the heading

S 245

local injection anesthesia After sterile preparation of the skin a sufficiently wide area is

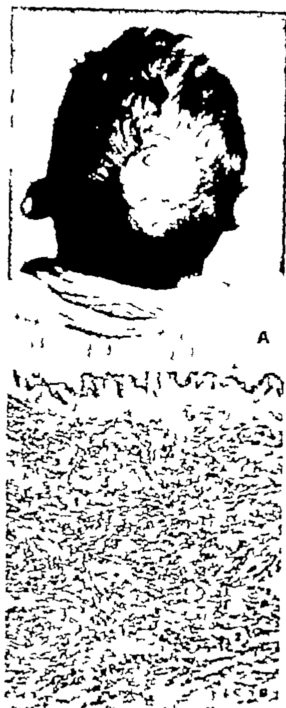


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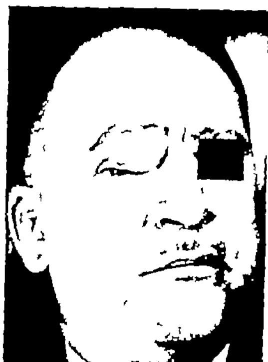


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occur singly or multiple. The hard cutaneous fibroma durum is sharply defined and elastic in consistency (Fig. 81). It is usually covered with normal skin unless it has been traumatized, resulting in ulceration and infection. They vary from ¼ to 2 or 3 cm in diameter. The soft fibroma is more frequently multiple, pedunculated, and may have a broad stalk (Fig. 82 A and B). Frequently the soft type contains nevoid cells that are seen in amelanotic melanomas. This latter group are more common in older persons and should be regarded with much suspicion. Frequently they are yellowish in color from the admixture of fatty and fibrous tissue.

Supernumerary auricles are embryonic anomalies and are placed under the heading

of fibromas These interesting tumors are composed of fibrous tissue covered with normal skin and may contain cartilage (Fig 83 A and B)

HISTOLOGY

Fibromas consist of connective tissue fibroblasts held together with collagenous in



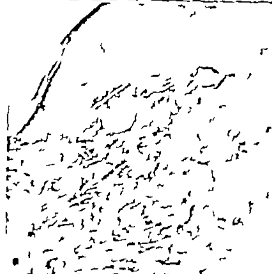


Fig. 82

A. Cutaneous fibroma, just beneath the chin Similar tumors on the opposite side of the neck. Growths are within the skin.

B Photomicrograph showing thickening of the various layers of the skin with slight downgrowth of fibrous tissue



Fig 81 Fibroma durum firm cutaneous fibroma, with long, narrow stalk.



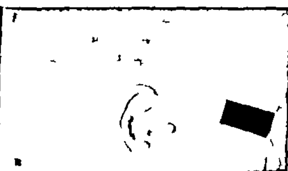


Fig. 83

A. Bilateral accessory auricles. B Opposite side of the face.

tracellular fibrillar substance which is the product of the fibroblasts and some of them contain nevoid like cells. The firm cutaneous fibroma (fibroma durum) frequently appears to be undergoing myxomatous degeneration The *soft fibromas histologically* resemble nerve tissue and are thought to arise from cutaneous nerves

CLINICAL FEATURES

The soft type is the more important of the two as they occur more frequently and more often become malignant especially true of those having a yellowish tinge It is in such fibromas that amelanotic nevoid cells are found and when incompletely removed or

irritated as by tying a string around their base, malignancy develops, the metastasis of which may contain much pigment



Fig. 84. Pedunculated fibroma popping right out of Mary's auditory canal. Complains she can t hear very well out of that ear No wonder Refused treatment growth now size of English walnut and distorting ear

and 85) The smaller are removed by electrodesiccation under local injection anesthesia



Fig 85 Papillary fibroma, lower eyelid the top of which has become ulcerated Removed with electrodesiccation. Good functional and cosmetic result.





Fig. 86

A. Papillary fibroma, right eyelid. Removed with electrodesiccation.
B Good cosmetic and functional results.

TREATMENT

These tumors should be removed surgically They develop slowly to rather large size and may undergo malignant change due to external irritation or infection torsion of the pedicle or trauma may lead to gangrene (Figs. 84 (Fig 86 A and B) The larger ones are surgically excised together with an adequate area of surrounding skin especially if the tumor is of the soft variety (see Fig 120 Chapt IV) The wound is closed with fine interrupted silk sutures (Fig 88) (Fig 89)

Keloids

Keloids are not true neoplasms, but rather an overgrowth of scar as a result of trauma burns, slowly healing infections, or surgical incisions. Some persons are prone to develop keloids, notably the Negro. Clinically they are firm smooth elevated pink to-red patches,

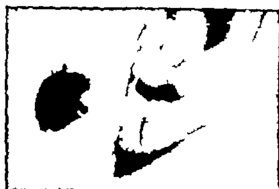


Fig. 87 Papillary fibroma left cheek three years duration. During the past year the growth has become very dark. Histological examination revealed amelanotic type of cells along with fibrous tissue. Surgical excision. No recurrence

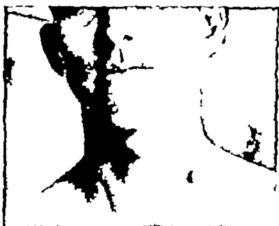


Fig. 88 Gill-cleft cartilage rests. (Courtesy A. E. Hertzler Surgical Pathology Skin and Fascia J. P. Lippincott Co.)

conforming more or less to the area of burn, trauma or scar. At times they form rounded or globular masses, 1 2 cm in thickness. Itching is a prominent symptom often noticed in the scar before growth of the keloid is demonstrable. Following extensive burns, the keloid also may be widespread and disfiguring

HISTOLOGY

Keloids are composed of dense fibrous tissue in bundles running parallel with the surface. They are relatively avascular

CLINICAL FEATURES

Their clinical significance is largely cosmetic although occasionally disfigurement and distortion are great enough to interfere with *normal functions*, most common in severe *burn scars*. Keloids are apt to recur after removal

TREATMENT

Since keloids have a marked tendency to recur complete eradication is difficult. Following the advice of the late John Staige Davis

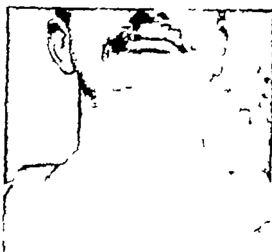


Fig. 89 Chondroma of the hyoid bone. Nodular masses attached to hyoid bone. (Courtesy A. E. Hertzler Surgical Pathology Skin and Fascia. J. B. Lippincott Co.)

and Curtis F. Burnam of Baltimore it has been our policy for many years to combine surgical removal with irradiation as follows

Flat keloids are given two threshold erythema doses of irradiation with x ray or radium. The choice of irradiation varies with the size and shape of the keloid. Long, narrow keloids are more readily treated by applying radium tubes in tandem along the area and at 1 cm distance. Thin keloids may melt away entirely or flatten and soften indicating radiosensitivity. Such response encourages the reapplication of a similar treatment in about two months. Two or rarely three treatments usually suffice to reduce these superficial keloids to a minimum of cosmetic worry and no other treatment may be needed

Round and patchy keloids if not too thick

(less than 2–3 mm) require the radium tubes to be arranged around the edges so that cross-firing upon all the keloid will result Keloids of this type may also be equally well treated with low voltage (100–140 Kv) roentgen therapy, unfiltered.

Large areas of keloid following burns, are preferably irradiated with roentgen therapy because of the large surface to be covered Doses of one to two T E D are given with low voltage (100–140 Kv), spaced about two months apart, until the scar is soft and pliable usually accomplished with two to three exposures.

The real problem keloids are the thicker globular ones following skin infections (Fig 90) and ear lobe punctures (Fig 91 A B C) When keloids are over 3–4 mm thick irradiation alone seldom melts them away These keloids are irradiated as outlined above, then surgically removed within two or three days Davis and Burnam emphasized the value of excising within the keloid at the edge, thus not stirring up further keloid reaction in the adjacent normal skin They felt that recurrences were due to reaction set up in the normal skin by the operation Closure should be without tension To accomplish this, wide keloids may have to be excised piecemeal The center is excised by an elliptical incision and closed with inverted fine silk sutures in the subcutaneous tissue The skin is closed with intradermal fine silk on a fine cutting (skin) needle (Kitlowski) Keloids that have repeatedly recurred should receive both pre and postoperative radiation

Very thick globular masses may require preoperative implantation of radon seeds or radium element needles to assure adequate irradiation throughout the keloid

Neurofibromatosis Von Recklinghausen's Disease Fibroma Molluscum

This is supposed to be a familial group of systemic diseases with not only cutaneous manifestations, but abnormalities in the internal organs and occasionally changes in the endocrine, nervous, and osseous systems, and also some mental retardation Both sexes are about equally affected Being a familial or congenital disease, the first symptoms may arise in early infancy or childhood

HISTOLOGY

There is fibrous tissue, some nevoid cells, and nerve tissue. Elastic fibers are seldom encountered

CLINICAL FEATURES

The cutaneous manifestations are the most constant and may appear in the form of pigment changes and either single or multiple disseminated tumors of varying size color and consistency The pigment changes frequently are the first symptom noted, occurring early on the exposed parts of the body, and simulate ephelides (freckles) Their color remains constant They are usually round or oval beginning as small spots, enlarging to several centimeters in diameter They resemble the color of coffee and milk so-called *cafe-au-lait* of the French (Fig 92 A B C)



Fig 90. Crop of keloids on nape of neck supposed to have followed furunculosis.

The tumors vary in size from a few millimeters to huge pedunculated masses referred to as fibroma molluscum and may be single especially about the head and neck to countless numbers over the body and extremities A variety of pigmented nevi may also be

present and occasionally hemangiomas or lymphangiomas.

These tumors begin as soft fibrous papillomas some remaining small others growing into huge pedunculated masses and are usually referred to as cirsoid neurofibromas They apparently grow from fine cutaneous nerves of the skin and frequently follow the distribution of the fifth cranial nerve (Fig 93 A B) or the upper cervical nerves. The smaller multiple tumors scattered along the course of a nerve, are often referred to as plexiform neuromas (Fig 94, A B) They are usually situated in the dermis or subcutaneous tissues but may lie deep in the neck when springing from nerve trunks or sympathetic nerves and are as a rule sharply demarcated from the surrounding tissues.



Fig 91

A and B. Keloids developed within four months after piercing lobes of ears for earbobs

C. Photomicrograph shows slight downgrowth of rete pegs. *Dense avascular fibrous tissue in bundles running parallel with surface*

The larger type of neurofibroma molluscum not infrequently extends to the deeper structures below the skin and may involve adjacent bone Cord-like areas in the tumor have the appearance of nerve trunks. This type of tumor is prone to undergo malignant change suspected when the base becomes firm and dense. It is estimated that malignant degeneration occurs in about 8 per cent of these tumors (Boyd) (Fig 95 A B)



Fig. 92 Neurofibromatosis. Multiple cutaneous tumors varying in size from a few millimeters to 1 cm. in diameter over face neck chest.

A Tumors over nape of neck spots present over body (café-au lait)

B Photomicrograph hypertrophy of rete pegs, nevoid cells, interspersed between fibrous connective tissue and elastic tissue cells

C Ulcerated lesion on lower eyelid Other lesions over body also ulcerated.

TREATMENT AND PROGNOSIS

Treatment of unsightly pigmented spots has not been successful. However the intradermal injection (tattoo) of permanent pigments may be of some value (Conway and Docktor) Since this disease lasts throughout life and there is no specific therapy, treatment is purely symptomatic. Large and unsightly tumors are removed by wide surgical excision and plastic repair if much skin is lost Tumors



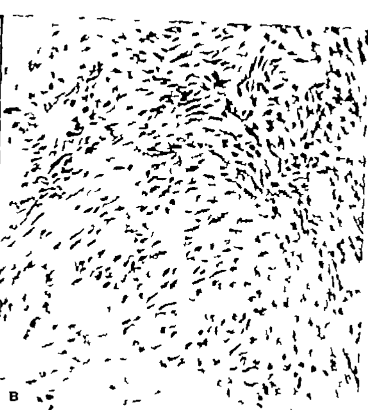


Fig 93

A Neurofibroma involving both the upper and lower eyelid (café-au lait) spots over face neck and chest. B Photomicrograph round nevoid cells long spindle fibrous tissue cells few elastic tissue fibers.



Fig 94 Plexiform neurofibroma involving the left upper eyelid B Photomicrograph shows nerve tissue and fibrous connective tissue

...n areas easily traumatized demand surgical eradication Frequent recurrences develop in the site from which pedunculated tumors have been incompletely removed Irradiation by x ray or radium is of no value

ADENOMAS OF THE SKIN

Sweat Gland Adenomas (hydradenomas)

Sweat gland adenomas (hydradenomas) are more frequently seen on the face than on other parts of the body They usually begin as firm circumscribed tumors within the skin being as a rule about $\frac{1}{4}$-$1\frac{1}{2}$ cm in diameter As they enlarge and grow they become cystic Their shape is for the most part spheroid projecting above the skin There is a clear area at the top where the skin may become thin and when traumatized a weeping ulcer results If malignancy develops there is a slowly spreading ulcer Frequently they contain comedo-like material Examined histologically the small tumors retain the structure of typical sweat glands On the other hand if there has been marked dilatation because of retained secretions hypoplasia of the epithelium occurs, having little resemblance to the original structure of the sweat glands



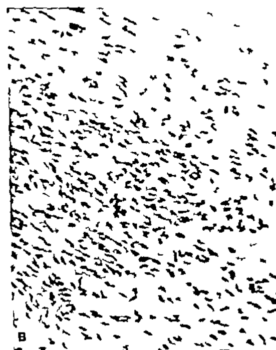


Fig 95

A Neurofibroma molluscum mass growing down from posterior area of scalp. Many small brownish nodules scattered over the body

B Photomicrograph Short spindle cells interspersed between homogeneous pale-staining fibrous connective tissue cells (×250)

Fat Gland Adenomas

Fat gland adenomas (sebaceous gland adenomas) are more frequently encountered over the cheeks, nose, upper lip and below the ears (Fig 96 A and B) They also form spheroid or globular tumors. Perhaps they are less likely to become malignant than sweat gland adenomas. However when malignancy does take place it seems to grow faster than those arising from the sweat glands. The familiar





Fig 96

A Adenomas in skin left side of nose and upper lip present three or four years. The top of the adenoma located on the nose is covered with telangiectases, and the skin is thinned out over the center

B Photomicrograph shows fat glands, groups of epithelial cells resembling basal cell carcinoma Marked round cell infiltration in some areas. Cystic spaces in some areas.

rhinophyma involves the skin of the nose, especially the tip of the nose and is a diffuse adenoma of the fat glands. Following mild trauma malignancy may develop When the fat gland adenomas are incised thick white material resembling cottage cheese, is expressed Histologically the structure is that



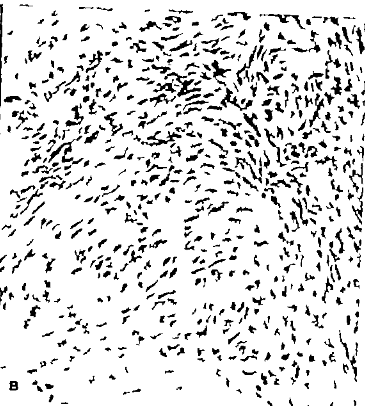


Fig. 93

A. Neurofibroma involving both the upper and lower eyelid (café-au-lait) spots over face, neck and chest. B. Photomicrograph: round nevoid cells, long spindle fibrous tissue cells, few elastic tissue fibers.



Fig. 94. Plexiform neurofibroma involving the left upper eyelid. B. Photomicrograph shows nerve tissue, fibrous connective tissue.

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ADENOMAS OF THE SKIN

Sweat Gland Adenomas (Hydradenomas)

Sweat gland adenomas (hydradenomas) are more frequently seen on the face than on other parts of the body. They usually begin as firm circumscribed tumors within the skin, being as a rule about ½–1½ cm. in diameter. As they enlarge and grow they become cystic. Their shape is for the most part spheroid, projecting above the skin. There is a clear area at the top where the skin may become thin and when traumatized a weeping ulcer results. If malignancy develops there is a slowly spreading ulcer. Frequently they contain comedo-like material. Examined histologically, the small tumors retain the structure of typical sweat glands. On the other hand, if there has been marked dilatation because of retained secretions, hypoplasia of the epithelium occurs, having little resemblance to the original structure of the sweat glands.



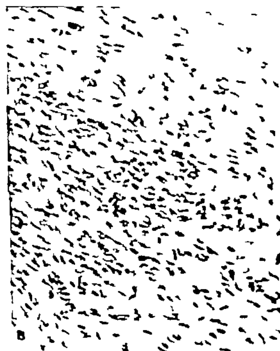


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of a normal fat gland when encountered early After they have grown to some size, a firm capsule of fibrous connective tissue develops around them In the beginning, they retain their appearance of normal fat glands, but later if malignant degeneration develops, they lose all the appearance of a fat gland.

TREATMENT

Surgical excision under local anesthetic is the method of choice for the larger tumors. The adenoma is excised with a margin of skin and the wound closed with silk sutures leaving *little deformity In the event that malignant* degeneration has developed, it is necessary to excise more widely Small adenomas, a few millimeters in diameter are eradicated with electrodesiccation under local injection anesthesia with a tiny white resultant scar

CYLINDROMAS SPIEGLER'S TUMORS OR *TURBAN TUMORS*

This group of tumors of the skin occurs on the head and neck but more frequently involves the scalp when they are given the term *turban tumors*

HISTOLOGY

Cylindromas have a characteristic appearance. The tumor is rather well demarcated in the corium It may be entirely separated from the epidermis by a connective tissue layer or sometimes diffuse with strands of the cylindroma extending out into the surrounding corium, or occasionally into the subcutaneous tissue. It is in this group that malignancy may develop Where nests of epithelial cells are well encapsulated and form long cylinder like structures, the term *cylindroma* is given. *Spiradenoma* indicates origin from sweat gland The epithelial cells are round or elongated staining rather deeply and contain a large circular or oval nucleus surrounded by a small zone of cytoplasm Frequently the outer row of cells simulates a typical basal cell carcinoma due to the palisading arrangement Sweat glands are sometimes found Pathologists differ as to the presence of sebaceous glands and hair follicles. After the tumor has been present *for some period of time, there may be* irritation of the epidermis followed by ulceration, otherwise, the epidermis above the tumor is usually intact These tumors may resemble *cystic adenoid epitheliomas* Turban tumors of the scalp as a rule, follow a benign course. Occasionally malignant degeneration takes place, in which event either basal or squamous cell carcinomas result



Fig. 97 Turban tumor Scalp covered with numerous globular tumors varying from one to several centimeters in diameter present fifteen years. In one tumor squamous cell carcinoma is present.

CLINICAL FEATURES

Often these benign epithelial tumors are grouped together to resemble a bunch of grapes or tomatoes. In neglected cases, they may be numerous and cover the entire scalp giving the appearance of a turban Some authors are of the opinion that there is an hereditary factor and have observed this group of tumors occurring through several generations.

They occur more frequently in females than males, are of slow growth and as a rule develop between the ages of twenty and forty years (Fig 97) Frequently they appear as multiple lobulated or mushroom like tumors, varying in size from a millet seed to that of a lemon Their color varies from that of normal

kin to a brownish or yellowish hue. They may be either pedunculated or have a broad base The ones that have a broad base are, as a rule smaller and firm

TREATMENT

In the majority of cases the tumors are so numerous and small that treatment isn t advised. Large growths, ulcerated ones, or those suspicious of neoplastic change require surgical



Fig. 98

A. Xanthoma involving the right upper eyelid and lips. Tumor involving the eyelid is reddish-brown in color and is composed of one tumor Those involving the lower lip and, to a small degree the upper are reddish-brown, papillar tumors measuring 3 or 4 mm in diameter

B Photomicrograph the connective tissue is infiltrated with large foreign body giant cells and large foam cells also moderate round cell infiltration.

excision. Frequently it is necessary to excise large areas of the skin due to the extensiveness of involvement followed by plastic repair Their high degree of differentiation, makes them resistant to radiation

XANTHOMA

This group of tumors is frequently encountered in one form or another They are usually circumscribed reddish yellow plaques, varying in size from a millet seed to 1 or 2 cm in diameter Occasionally they may coalesce and form rather large pedunculated masses situated around the eyelids, the inner canthus of the eye, the temple region cheeks, and the neck. They are also noted about the large joints especially the hips, knees, and elbows Only the ones involving the skin of the neck, face, and scalp will be considered here They not infrequently involve the mucous membranes especially of the bronchi, larynx, and mouth

There are two general types one more frequently involves the eyelids or the area around the medial canthi of the eye, and are referred to as *xanthelasma* This type may occur in profusion The second group are, as a rule, yellowish or reddish yellow formations that are one, two or three centimeters in diameter and are slightly elevated (Fig 98 A and B) Xanthomas, occasionally noted in youth are more frequently encountered during middle age. As a rule, they grow to a certain size and then remain stationary unless chronically irritated It is contended by some that they undergo malignant change but our experience does not bear this out

ETIOLOGY

Xanthoma is probably a cutaneous manifestation of a disturbed metabolism They are frequently noted in patients who have disorders of the liver pancreas or kidneys Hypercholesteremia has been reported by some investigators Their frequent occurrence in patients with uncontrolled diabetes has been noted for a long time In this connection there has been a controversy whether xanthoma should be considered a neoplasm or a disturbance of lipoid metabolism with skin manifestations. The common xanthelasma about the lids however are not associated with general systemic diseases

CLINICAL BEHAVIOR

The small millet seed lesions on the eyelids and around the internal and external canthi of the eye usually remain stationary or coalesce to form large unsightly patches up to ½–1 cm or even larger They produce no symptoms. The larger nodular lesions are firm quite painless, and elastic to the touch When incompletely removed, they may recur which would lead some to think they were malignant If their entire capsule is removed there should be no recurrence

HISTOLOGY

There is fibrocellular involvement in the middle and lower thirds of the cutis. Foreign body giant cells with large foam cells are scattered throughout the connective tissue. The presence of these two types of cells formerly aroused concern in that they were thought to be a form of sarcoma The large xanthoma foam cells contain lipoid material They frequently are abundant and give the gross specimen a yellow appearance. The connective tissue may be either sparse or abundant

TREATMENT

The lesions on the eyelids, called *xanthelasma* may be efficiently removed by injecting local anesthesia around and beneath The full thickness of the thin skin is destroyed by an electrodesiccating current on a fine needle, care being exercised not to pierce deeply to cause undesirable scar

Two per cent gentian violet solution in 10 per cent acetone and 50 per cent alcohol is applied forming an aseptic protecting crust. No dressing is needed and the patient may wash the face *ad lib* This crust comes away in three or four weeks as healing takes place beneath A pink soft scar gradually fades into an almost imperceptible cicatrix with no distortion of the lids.

A word of warning Never treat a large number of xanthelasma involving both upper and lower lids near the inner canthus at one sitting In so doing the treated areas may coalesce the resulting scar causing a fold of skin to stretch over the inner canthus between it and the nose This curtain like fold is a source of annoyance as it is more visible to the patient than to the observer To correct such a complication the fold is incised longitudinally and sutured transversely To prevent this difficulty multiple xanthelasmas should be treated during several sittings Those on one lid are treated at one time and when healing is complete those on the other lid are treated

The larger lesions located elsewhere on the face and neck, one or two centimeters in diameter are either excised or destroyed with electrodesiccation It is quite necessary to completely remove the entire capsule to prevent a recurrence Local injection anesthesia is sufficient for excision or electrodesiccation

LIPOMAS AND MYXOMAS

Both of these tumors occur around the head and neck the latter being the most common site of the body involved The back of the neck and the region just beneath the chin are most commonly affected They may occur either superficial to or beneath the deep cervical fascia Lipomas are the most innocent of tumors when they occur in a superficial position The ones lying beneath fascial planes have more clinical significance than those that occur above since they offer difficult problems in differential diagnosis and at operation are often hard to remove The deep-lying lipomas

(10%) (Boyd) are more apt to become malignant than the superficial ones As a rule, these tumors grow slowly It is not infrequent that they are permitted to become large and disfiguring They are practically symptomless except for pressure phenomena when deeply situated and following irritation either by irradiation or an inflammatory process in their neighborhood become firm painful and are less well encapsulated Finger like projections may grow out between the fascial layers and between the muscle bundles or between adjacent muscles, frequently rendering surgical removal difficult It is essential that the tumor and its capsule be removed in toto It is in this type of tumor that the gradation from a parent lipoma to a myxoliposarcoma is rather difficult to detect clinically

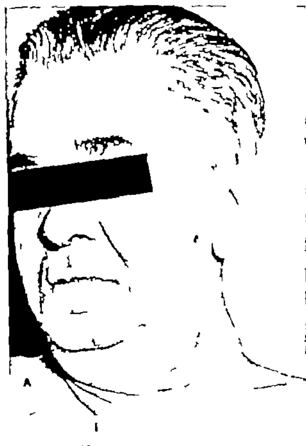




Fig 99

A Lipoma, posterior triangle of neck producing globular tumor present for fifteen years soft fluctuant lobulated

B Gross specimen showing lobulations Pathological diagnosis fibrolipoma.

tender and the overlying skin becomes reddened and indurated

Lipomas

Lipomas consist of normal fat arranged in irregular lobules separated by definite fibrosepta and the entire tumor surrounded by a delicate capsule of connective tissue This is not always true if they lie deeply that is, under the fascia and on top of muscle They seem to cling to the fascial planes muscles, and connective tissue septa The deeper ones

HISTOLOGY

These tumors are composed of normal appearing fat cells, arranged in lobules, separated by fibrous septa.

CLINICAL FEATURES

Clinically when the lipomas are located superficially they produce definite encapsulated tumors that are soft in consistency (Fig 99 A and B) On the other hand when found beneath the superficial or deep layer of fascia,

they produce protuberant gibbous tumors with an indefinite outline. Growth beneath the cervical fascia develops pressure, makes for firm consistency often causing them to resemble a cyst. Their very unusual location at times, plus the probability of their being irritated by the injudicious use of irradiation, are frequently interesting diagnostic problems. This was noted in a patient who had a lipoma in the anterior surface of the neck over the third case was in a male forty years of age who had a deeply lying lipoma on the anterior lateral surface of his neck along the anterior border of the sterno-mastoid muscle. His shirt collar constantly produced pressure on the tumor which became tender He was given a course of radiation and developed such extensive reaction that there was disturbance with deglutition and respiration. When these tumors were removed they were

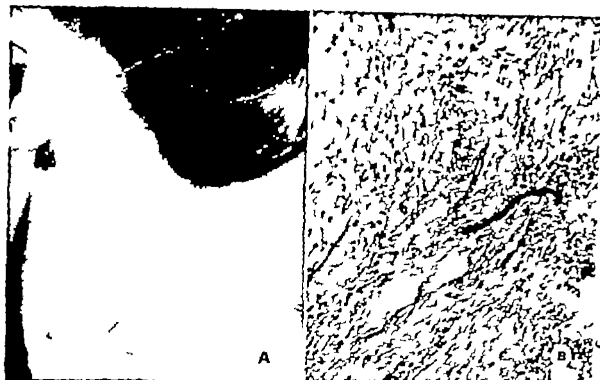


Fig. 100. Myxoma, left side of neck

A White female, 38-years-old lump left side neck 2 years duration. Began active growth 6 months ago 4 cm. diameter firm, mobile tumor Radical neck dissection no recurrence 3 years.
B Photomicrograph malignant myxoma.

region of the thyroid gland According to the history it had all the appearance of a mild, diffuse toxic goiter with nervousness, tachycardia and loss of weight. Radiation was given over the tumor which was followed by rapid growth and redness of the skin. When seen, the tumor had the appearance of a rapidly growing sarcoma Another such case was noted in a male with a small globular tumor in the infraorbital area that was producing no symptoms other than its appearance. Following radiation the skin became reddened, the tumor rapidly enlarged and became firm appearing as a rapidly growing sarcoma The densely adhered to all the surrounding structures, adding danger and difficulty to their removal

If there is a history of rapid growth these apparently innocent tumors should be carefully sectioned to ascertain the presence of malignancy Microscopically malignancy will be revealed by islands of embryonic fat along with adult fat and myxomatous stroma Also there may be immense giant cells with foamy cytoplasm The embryonic fat cells occasionally resemble small liver cells with a granular cytoplasm

Frequently following the injudicious treat

ment with irradiation, the microscopical picture will simulate malignant change except that there is a marked increase in the fibrous tissue which is not evident in malignancy. The tumor becomes more cellular with an abundance of giant cells and embryonic appearing fat cells.

Myxomas

Myxomas are not as frequently encountered as lipomas, but as a rule occur in the same locality. They are in general more deeply situated and more diffuse in outline, and tend to insinuate themselves between muscle and fascia planes as they enlarge. When malignancy develops, their growth is rapid and the tumor becomes firm and immobile (Fig. 100 A and B). Every tumor when removed should be carefully examined for transitional changes into malignancy. One such patient was seen by J. W. H. who operated for an indefinite lobulated tumor on the left side of the neck. The patient gave a history of four previous operations and radiation therapy. Following extensive exposure of the tumor, it was found that one area had a very thick capsule and had grown deeply between the muscle layers. Microscopical examination showed areas of firm typical myxosarcoma. Other areas showed typical myxoma.

Treatment

Lipomas and myxomas should be carefully removed by wide surgical excision. In planning such an operative procedure, it is well to bear in mind, especially if the tumor is located beneath the deep fascia, that all ramifications must be pursued to completely remove the neoplasm from between muscles and all deep structures. All adherent fascia and muscle must be taken with the tumor.

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Chapter IV

MALIGNANT NEOPLASMS OF THE SKIN OF THE HEAD AND NECK

MALIGNANT EPITHELIAL NEOPLASMS OF THE SKIN OF THE HEAD AND NECK

Malignant lesions of the skin are easily accessible for careful examination early diagnosis, and adequate treatment, therefore, it would seem that excellent results should be obtained in a high percentage of cases Unfortunately this idealistic plan is too frequently violated as each year a large number of patients with skin cancer consult our clinics with lingering disease who have been treated for months or years apparently because too little significance was attached to the lesion in its early stages, and also because of inadequate treatment. If intelligent and proper therapy is to be administered the patient should be seen when the lesion is small adequate biopsy taken the patient and the growth evaluated and the treatment administered at that time which will eradicate the disease Only by following such an intelligent program can the extensive involvements so frequently encountered in our clinics be prevented

Malignancies of the skin vary greatly in their pathological manifestations and clinical behavior ranging from the slowly-growing semimalignant basal cell tumors to the very malignant squamous cell cancers The indolent, slowly-growing basal cell carcinomas if not stimulated by inadequate therapeutic measures, are lazy in their growth until they reach the mucous membrane of the nose or conjunctiva, when they begin to spread with increased vigor simulating the rapidity of squamous cell cancers Squamous cell carcinomas of the skin are as a rule much less malignant their growth is slower with less tendency to form metastases than like tumors found on the mucous membranes of the oral cavity

In the chapter on benign skin tumors, it was stressed that certain lesions, as hyperkeratoses, senile warts, and papillomas, are premalignant or precancerous. All too frequently after they have become agitated from some chronic irritant (weather, shaving poor treatment) malignant changes take place It cannot be emphasized too strongly that the removal of such lesions in their benign state will prevent later malignancies and save the patient many distressing experiences necessary to eradicate the disease

It is necessary in selecting treatment to differentiate between histological types The literature gives several main and subgroupings. The following classification seems to be of clinical and histological value

1 Basal cell carcinoma
2 Squamous cell carcinoma or epidermoid carcinoma with varying degrees of cellular differentiation
3 Adenocystic basal cell carcinoma (this latter group probably arises from skin appendages)

Basal cell carcinomas are frequent. As a rule, there is a history of the lesion s being present for a period of months or years before it becomes active The tendency is for the growth to remain local and to slowly destroy the entire thickness of the skin, subcutaneous tissue muscle, fascia bone or even an eye, ear and later perhaps, to erode blood vessels, occasionally producing excessive hemorrhage. These tumors seldom produce regional or distant metastases as basal cells but, without rhyme or reason, squamous cell changes may develop resulting in metastases into the lymph drainage area.

Squamous cell carcinomas are next in frequency Their growth is more rapid with infiltration and fixation, varying in degree

with their histological differentiation. They produce local *and distant metastases.*

Adenocystic basal cell carcinomas, clinically lie between basal and squamous cell types They grow more rapidly than basal cell carcinomas and less rapidly than squamous cell carcinomas and at times metastasize to regional lymph nodes. They are more difficult to eradicate by irradiation than basal cell carcinomas, due to their cellular differentiation The areas of predilection in all types of lesions are the nose cheeks ears, and eyelids as illustrated in Table 3 although all three types may occur anywhere on the skin

TABLE 3

LOCATION OF 840 EPITHELIAL TUMORS OF THE SKIN OF THE HEAD AND NECK

Eyelid	94 Cases
Nose	244 Cases
Cheeks	217 Cases
Forehead	79 Cases
Ears	99 Cases
Scalp	34 Cases
Chin	14 Cases
Neck	42 Cases

ETIOLOGY AND PREDISPOSING FACTORS

It has been our experience and that of others, that individuals without much pigment in their skin and/or having a thin dry skin are frequent candidates for epithelial malignancy The converse is also true in that epithelial malignancy is infrequently encountered in the skin and lips of the negro or yellow races Thin-skinned blond individuals, who are exposed to the elements and intense sunlight, working as ranchers, farmers sailors, etc and especially sailors who are exposed to the additional reflection of sunlight from the water and salt water spray frequently develop basal and squamous cell carcinomas *It is not uncommon to observe in such individuals* multiple benign and malignant lesions lasting over a period *of years.* One of our patients from the Southwest has had thirty four separate basal and squamous cancers of the face and neck The adenocystic variety is infrequently encountered in such individuals. The thin-skinned, blond person frequently develops keratoses and eczematoid areas on *the nose* cheeks, over the zygomatic areas, and ears. When such lesions are further insulted by *small doses of irradiation,* resulting in fibrosis and endarteritis the tendency for malignant transformation is *enhanced. Skins* that are too sensitive to tolerate intensive sunlight and wind are too sensitive *to be* treated with irradiation Such patients should be treated with electrodesiccation of the small lesions and excision of larger ones and skin

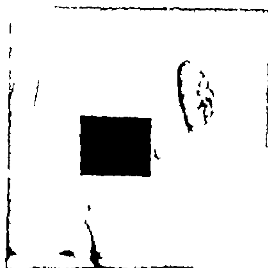


Fig 101 Patient with hyperkeratosis over the fore head and temple areas for 15 years. One year ago, area of hyperkeratosis took on increased activity over the left temple. Biopsy basal cell carcinoma.

grafting if necessary These individuals should protect their skins as much as possible when exposed to the elements by a generous application of a cream Figure 101 illustrates the importance of people with hyperkeratoses protecting against further exposure to sun light and wind This patient has had hyper keratoses of the forehead and temple areas for the past fifteen years much worse during the summertime The lesion over the left temple is a basal cell carcinoma

Patients with papillomas, warts and moles that are chronically irritated by shaving or brushing their hair should have such lesions adequately removed before malignant transformation develops

Patients that have seborrheic skin are prone to develop epithelial malignancies especially over the nose in the nasolabial fold and zygomatic areas of the cheek Squamous cell



Fig 102
A. Papilloma on the right cheek irritated by shaving Began to grow
B. Photomicrograph shows nests of epithelial cells with varying size and chromaticity Epithelial pearls present. Diagnosis squamous cell carcinoma

carcinoma is more common in this type of skin than basal cell carcinoma When such individuals have repeated small doses of irradiation over a period of years which produces endarteritis and fibrosis carcinomatous changes are frequent. The entire thickness of the skin seems to be involved all at the same time (Figure 103)

Studies by Figge and co-workers revealed that some tissues (cervix, mammary gland, skin or face) subject to a high cancer incidence also show a high level of porphyrin excretion. People who excrete a large amount of porphyrin in the sebum are thought to be more susceptible to skin cancer Sebum is secreted in large amounts from sebaceous glands in the skin about the eyes and nose an area where skin cancers are most common



Fig 103 Patient had seborrheic dermatitis since childhood Treated repeatedly with x ray Developed squamous cell carcinoma nasolabial fold that eventually perforated the ala and involved the turbinate.

Scars resulting from burns or other trauma over the face ears and neck are likely to undergo malignant changes as the years pass by especially if chronically irritated If wide scars are present on thin skinned blond people that are exposed to the elements, there is a great possibility of malignancy developing. The scar should not be irradiated, as further insult will thereby be added to the already damaged tissue Excision and grafting either with a split thickness or pedicle graft, is the treatment of choice

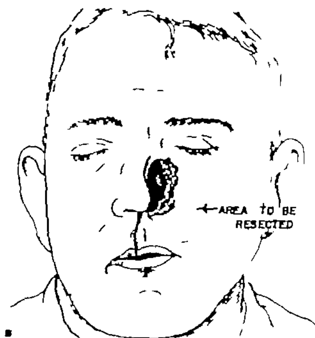
Chemical irritants accidently splashed on the skin may act as carcinogenic agents the cancer developing after a period of time Tar, pitch, or arsenic preparations are a few of the chemical agents prone to stimulate keratoses

which later are followed by malignant change

A recent case illustrates the carcinogenic

railroad ties. In one burned area, a rap growing squamous cell carcinoma devel





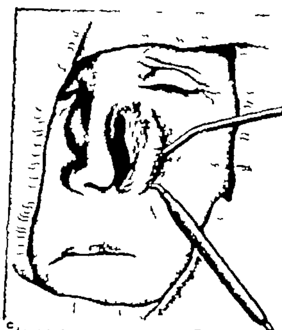


Fig 104 A–C

A. Squamous cell carcinoma destroying the ala of the nose of the left side resulting from burn with creosote arsenic preparation for dipping cross ties. Scars on cheeks, lips, and ala of the nose on the right side from previous burns.

B Shaded area to be resected. Incision down midline of lip and lip turned back for adequate exposure of involved gingiva.

C. Incision with electrotome. Aspirator keeps wound dry —only a few large vessels bleed and are controlled with a ball-tipped coagulator

D Involved soft tissue and wide margin removed Chisel resects diseased bone surface of bone then sterilized with ball coagulator

E. Wound clean and ready for closure of lip Note antra nasal wall and adjacent involved structures partially resected

F Border of lip resutured Previously prepared prosthesis in place improves eating and talking

properties of certain industrial chemicals. The patient is a man who gave a history of having his face repeatedly burned with creosote arsenic mixture used for preserv

which destroyed the le[illegible] ala of the nose (Fig

patients o [illegible] trophic areas skin of the [illegible] ears and

posterior surface of the neck perhaps on a nutritional basis, which are frequently followed by an eczematoid condition When such areas are repeatedly treated with small doses of irradiation, not infrequently basal or develops and the lesion refuses to heal. Biopsy reveals an anaplastic squamous cell carcinoma. Patients with seborrhea and acne form the basis for more of the skin malignancies in younger patients.

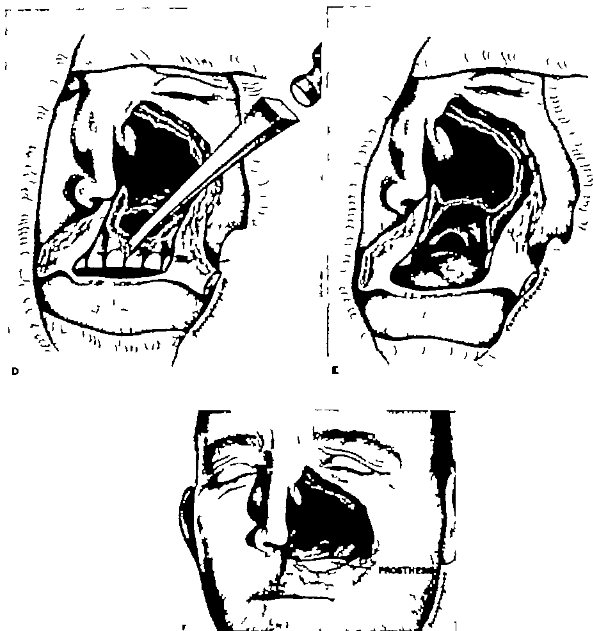


FIG. 104 D-F

squamous cell carcinomas result. Such lesions are difficult to eradicate as they have been treated for the eczematoid condition by a spray type of irradiation which adds confusion to the normal physiology of the skin Persistent acne over the cheek and nose may concentrate in one area and after a period of time induration, ulceration and infiltration

INCIDENCE

A study was made of the epithelial malignancies of the skin of the head and neck from the Tumor Clinics of the Johns Hopkins Hospital and the University of Maryland Hospital and our private files from January 1930 to June 30 1945, a period of fifteen years. All

cases were included from the private files dur ing that period, however the large amount of material in the Johns Hopkins Hospital and University of Maryland Hospital Clinics

TABLE 4

Ages of 840 Cases

14–30 years	44 Cases
30–40 years	34 Cases
40–50 years	131 Cases
50–60 years	176 Cases
60–70 years	213 Cases
70–80 years	178 Cases
80 years plus	64 Cases

of a Gallop Poll, which was considered suf ficiently accurate for our study by the bio statistician of the Johns Hopkins Hospital, Dr R A Rider

A group of 840 patients was carefully studied as to age predisposing factors sex, previous treatment and the treatment utilized in our clinics was evaluated Males were more frequently affected than females there being 67 per cent males and 33 per cent females. Skin cancer was more frequently seen as other forms of cancer in the older age group 50 per cent were over sixty years of age How ever Table 4 shows that forty four patients

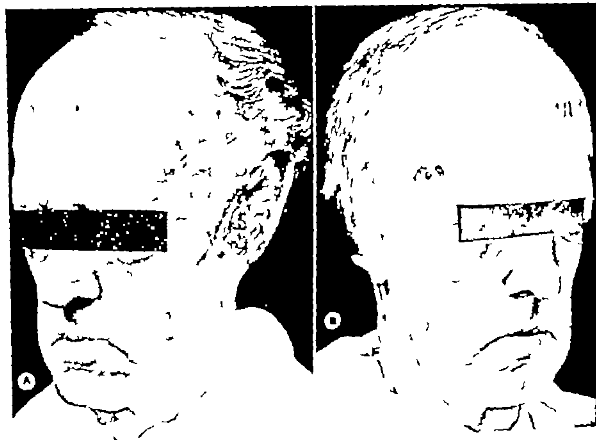


Fig 105

A and B 78-year-old male a native of the Southwest has a thin dry skin without much pigment Developed a basal cell lesion over the zygomatic area of the right cheek 36 years ago. Since that time has had 31 distinct and definite basal and squamous cell lesions on the face and neck

would not permit a careful analysis of every case Consequently only every fourth history was reviewed giving a fairly accurate repre sentation of the problems involved and the results obtained The two groups from the teaching institutions constitute more or less

were under thirty years of age and twelve of these were under twenty years of age Sixty four of these patients were over eighty years of age This latter fact is important in selecting the most efficacious type of treatment for them.

Table 3 depicts the location of these lesions There is some duplication in numbers due to the fact that several patients had one or more malignancies during their period of observation Eighty-one per cent of the 840 patients had basal cell lesions A number had two basal cell carcinomas at one time Others had three and fourteen had both a basal cell and squamous cell cancer at the same time (Fig 105 A and B)

PATHOGENESIS

As enumerated above the various types of skin cancers behave differently clinically They therefore will be discussed as three separate types

BASAL CELL CARCINOMA (JACOB S ULCER RODENT ULCER KROMPECHER S CANCER)

This group of lesions, as the name implies develops from the basal cell layer of epithelium. There are several clinical varieties (1) One beginning in thin dry skin, without much pigment, first appears as a piling up of silvery scales (hyperkeratoses) which when removed, leave a purplish base If the lesion progresses, hyperemia develops around its edges. It is tender When the scales are removed from the slightly more advanced lesions oozing of serum or bleeding occurs. Histologically clumps of basal cells are noted just

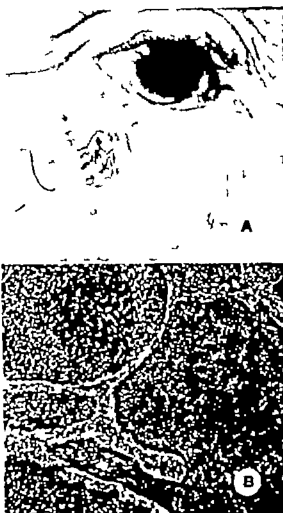


Fig 106

A Basal cell carcinoma below the outer canthus of the right eye with ulceration of the center rolled up edges

B Photomicrograph showing clumps or nests of epithelial cells varying in size and chromaticity Illustrating typical palisading noted in basal cell carcinoma Moderate round cell infiltration.

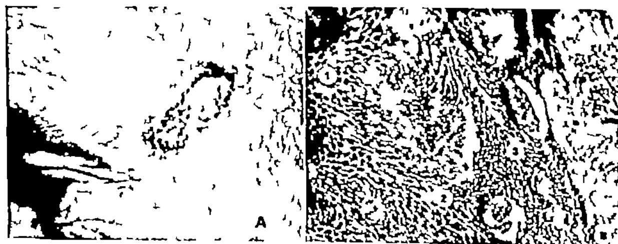


Fig. 107

A Lesion of the left temple developed in an area of skin that had been treated for chronic eczema for a period of years. 18 months ago a superficial ulcer developed which has healed over several times, each time to re-ulcerate Biopsy intracutaneous basal cell epithelioma, or Bowen's disease.

B Photomicrograph shows intra-epidermal dyskeratosis.

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TABLE 4

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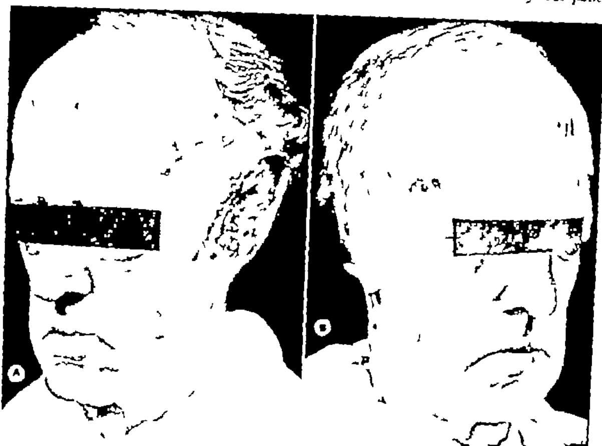


Fig 105

A and B 78-year-old male a native of the Southwest has a thin dry skin without much pigment Developed a basal cell lesion over the zygomatic area of the right cheek 36 years ago Since that time has had 31 distinct and definite basal and squamous cell lesions on the face and neck.

would not permit a careful analysis of every case. Consequently only every fourth history was reviewed giving a fairly accurate representation of the problems involved and the results obtained The two groups from the teaching institutions constitute more or less of a Gallop Poll which was considered sufficiently accurate for our study by the biostatistician of the Johns Hopkins Hospital, Dr R. V Rider

A group of 840 patients was carefully studied as to age predisposing factors, sex, previous treatment, and the treatment utilized in our clinics was evaluated Males were more frequently affected than females there being 67 per cent males and 33 per cent females. Skin cancer was more frequently seen, as other forms of cancer in the older age group 50 per cent were over sixty years of age However Table 4 shows that forty four patients were under thirty years of age and twelve of these were under twenty years of age Sixty four of these patients were over eighty years of age This latter fact is important in selecting the most efficacious type of treatment for them.

Table 3 depicts the location of these lesions There is some duplication in numbers due to the fact that several patients had one or more malignancies during their period of observation. Eighty-one per cent of the 840 patients had basal cell lesions. A number had two basal cell carcinomas at one time Others had three, and fourteen had both a basal cell and squamous cell cancer at the same time (Fig 105 A and B)





Fig 106

A. Basal cell carcinoma below the outer canthus of the right eye with ulceration of the center- rolled up edges

B Photomicrograph showing clumps or nests of epithelial cells varying in size and chromaticity illustrating typical palisading noted in basal cell carcinoma. Moderate round cell infiltration.

Pathogenesis

As enumerated above the various types of skin cancers behave differently clinically They, therefore will be discussed as three separate types.

BASAL CELL CARCINOMA (JACOB S ULCER RODENT ULCER KROMPECHER S CANCER)

This group of lesions, as the name implies, develops from the basal cell layer of epithelium There are several clinical varieties (1) One beginning in thin dry skin without much pigment, first appears as a piling up of silvery scales (hyperkeratoses) which when removed leave a purplish base If the lesion progresses, hyperemia develops around its edges. It is tender When the scales are removed from the slightly more advanced lesions, oozing of serum or bleeding occurs Histologically clumps of basal cells are noted just

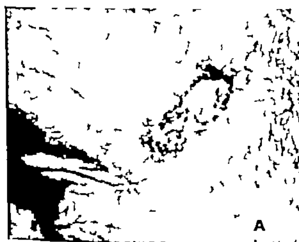


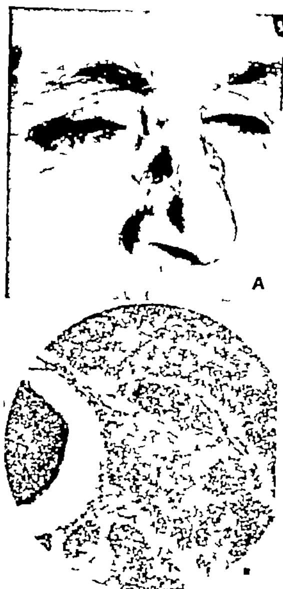


Fig 107

A A Lesion of the left temple developed in an area of skin that had been treated for chronic eczema for a period of years. 18 months ago a superficial ulcer developed which has healed over several times, each time to re-ulcerate. Biopsy intracutaneous basal cell epithelioma, or Bowen s disease

B Photomicrograph shows intra-epidermal dyskeratosis.

beneath the dermis, seldom having the typical palisading that is encountered in the next group Figure 105 A and B is typical



(2) A second group develops in a previously normal skin as a pearly lobulated, translucent, flat, and slightly elevated nodule at first superficial, remaining stationary for a long time one of the cases as long as twenty years. If permitted to persist they produce bulky growths with telangiectases over the surface, later ulcerating leaving rolled up edges. Gradually they become firmly fixed to the deeper structures. This is shown in Figure 106 A and B a lesion beneath the outer canthus of the right eye

(3) The third group develops in eczematoid areas of the skin often following the use of astringent lotions. A superficial ulcer appears involving the outer layer of the skin There is recurrent healing and re ulceration they never develop the typical rolled up edges noted in the previous group The lesion frequently migrates over a large area for long periods of time without infiltrating deeply When examined early the nests of cells are found within the skin It is sometimes referred to as intracutaneous basal cell epithelioma or Bowen s disease (Fig 107 A and B)

(4) Occasionally people with blackheads

Fig. 108

A. Patient had crops of blackheads on the face for a period of years. One year ago several blackheads seemed to develop at the same time and became irritated. Later a nodularity developed within the substance of the skin, the lesions coalesced. Both sides of the nose were affected at the same time

B Photomicrograph showing typical basal cell epithelioma with a palisading and only slight amount of connective tissue stroma. Some mitoses are present

Plate I

A. Early basal cell carcinoma, right cheek, elevated lesion with telangiectases over surface This type cancer is eradicated with 4500 r with sufficient margin around tumor

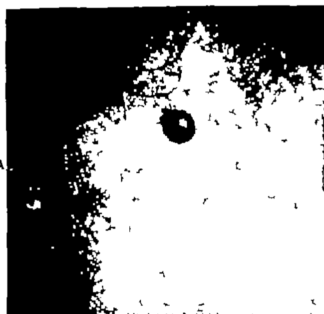
B Early basal cell carcinoma beneath right eye Center shows umbilication and ulceration. Eradicated with 4500 r with sufficient margin around tumor Pale scar right side of nose after above treatment for a similar lesion.

C. Rodent ulcer (basal cell carcinoma) right temple treated with salves 18 months. This type cancer best eradicated by surgical excision giving a wide margin and split thickness graft Radiation will destroy growth but leaves thin ischemic scar which tends to break down from slight trauma.

D Basal cell carcinoma beneath right eye present 4 years Persisted during inadequate radiation therapy Growth extends to medial canthus. Treatment wide electrosurgical excision with appropriate graft

E. Basal Cell carcinoma, right nasolabial fold, 6 months duration Inadequately treated with irradiation Sufficient dosage of irradiation was given but insufficient margin allowed around tumor Note small nodule on medial margin. Histological examination showed persistence of growth Treatment surgical excision pedicle graft

F Extensive basal cell carcinoma, right nasolabial fold 4 years duration Growth persisted during repeated inadequate irradiation treatments Tumor now involves right side of nose medial surface of right cheek and extends through nose and has eroded mucous membrane Such cancers require extensive electrosurgical excision with pedicle graft at later date


A


B


C


D


E


F

omedones) in the skin of the face observe, ter a time that several of the blackheads in ie group apparently become inflamed simul neously Examination reveals a nodular owth within the skin with subsequent small iperficial ulcerations having slightly rolled) edges. As the lesions persist they even ally coalesce Such growths penetrate deeply id if located on the nose or ear may infiltrate hrough the cartilage to involve the nasal mucous membrane or both sides of the ear Fig 108, A and B)

(5) The deep type of basal cell carcinoma pparently develops in the deep substance f the skin and extends over a large area before lcerating By the time ulceration is manifest, he entire thickness of the skin is destroyed he growth extending into the subcutaneous ssue Such lesions not infrequently occur in atients with areas of hyperkeratoses. When hey appear on the nose the entire thickness f the skin is destroyed early and the growth extends into the nasal cavity and sinuses (Fig 109 A and B)

Practically all basal cell carcinomas are of slow growth as compared with squamous cell carcinoma but when they involve the conjunctiva or the mucous membrane of the nose, their growth becomes rapid This is probably due to the increased blood supply and less resistance of the mucous membranes to tumor growth a factor enhanced by the lack of fibrous tissue which is so prominent in the skin. Not infrequently especially on the scalp and temple neglected basal cell cancers attempt healing in one area, while active growth continues in others, producing the complicated network to confuse the untutored.



Fig 109

A. Patient with hyperkeratoses for several years developed a lesion over the nose that rapidly destroyed the ose the growth extending into the nasal sinuses. Photo is of recurrence after much treatment illustrating invasive haracteristics.

B Photomicrograph showing basal cell carcinoma groups of cells with typical palisading and squamous changes. Moderate round cell infiltration.

SQUAMOUS CELL CARCINOMA

Squamous cell carcinomas differ from the basal cell group in that they develop from the prickle-cell layer of skin. They are less frequent than the basal cell type and more common than

the adenocystic type There were 12 6 per cent squamous cell carcinomas in our series. This cancer is characterized by more rapid growth and invasion, bulkier tumors, and earlier ulceration

Squamous cell carcinomas at times take origin in epithelial papillomas, warts, cutaneous horns, scars resulting from burns, or broken-down scars from tuberculosis of the

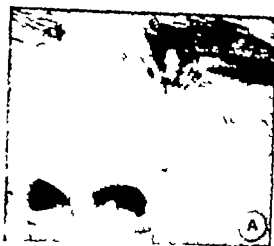


Fig 110

A. Patient developed pimple left cheek 2 months ago The lesion failed to heal and bleeds after drying his face with towel. Lesion is ½ cm in diameter indurated. Biopsy squamous cell carcinoma

B Photomicrograph infiltration with strands and nests of epithelial cells, moderate round cell infiltration

The ulceration is surrounded by a duration Not infrequently they de previously normal-appearing skin "pimple which fails to heal and is s by a zone of induration (Fig 110, A

skin, as l and scar benign le aving h irri

s or lupus erythematosus ated x-ray therapy to or seborrheic eczema the hair are traumas hes Their



PLATE II

A. Squamous cell carcinoma developing in keratosis. Treatment surgical excision with wide margin split thickness graft.

B Squamous cell carcinoma, one year's duration posterior area of left ear Metastases to adjacent lymph node. Treatment wide surgical excision, neck dissection and pedicle graft if necessary

C. Big trees from small acorns grow Patient burned left side of nose with creosote arsenic cross-tie dip devel oped squamous cell carcinoma, left nasolabial fold one year previously Treated with salves until ala of nose fell out. Treatment electrosurgical excision. Photograph taken after treatment. When basal or squamous cell carci noma involves mucous membranes the activity increases and they are difficult to control by surgery electro surgery or radiation. Regrowths appeared in this patient and were treated by caustic doses of radiation.

D Sturge Weber syndrome. Extensive hemangioma involving left side of face, lips, gums, and cranial vessels. (See text, "Hemangiomas.") Hypertrophy of mucosa of upper lip looks like tongue.

E. Malignant melanoma, right temple. Bluish black mole present several years. Unsuccessfully removed else where with electric needle twice during past year Treatment wide excision of tumor with radical neck dis section (Pack technic) (see text)

F Photomicrograph of malignant melanoma showing invasion by non-pigment and pigment-containing cells.

development from previously benign lesions is so frequent as to demand stressing that all benign lesions should be removed (Figs. 111, A, B, and C, 112 A and B and 113) Fre tumor The biopsy revealed squamous cell carcinoma Grade II, with metastases to the submaxillary lymph nodes.

Squamous cell carcinomas develop in scars

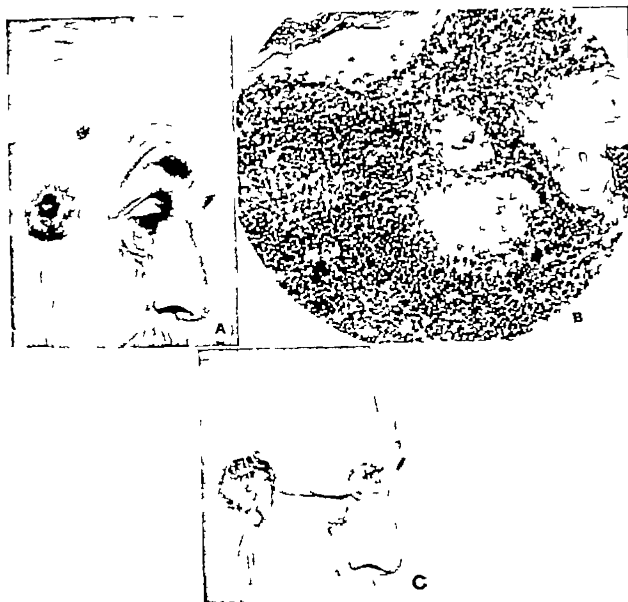


Fig 111

A. Patient had a "flat wart over the right cheek, also smaller flat, senile warts over the right temple. Six months ago the lesion on the right cheek became painful the border irritated red, and inflamed Examination an ulcerated, elevated firmly fixed lesion.

B Photomicrograph Infiltration of the subcutaneous tissue with epithelial cells varying in size, and with deep-staining nuclei. Epithelial pearl present.

C. Lesion removed with electrosurgery the destruction of tissue extended a centimeter around the periphery and down to the temporal fascia. The wound was permitted to granulate and later grafted

quently small squamous cell carcinomas metastasize early (Fig 114 A and B)

Epithelial malignancies are infrequent on the skin or lips of the colored race The patient shown in Figure 115 A gave a history of a slight ulceration on the right cheek six months previously which was followed by a bulky

from burns, lupus vulgaris and lupus erythematosis (Fig 116 A B, and C) These lesions are of low histological grade and their slow development is apparently due to the associated fibrosis Multiple carcinomas may develop Such scars, whether containing cancer or not, should be removed by surgical excision

and grafted. The patient, a white male, had lupus erythematosis and vulgaris for several years His occupation was that of an overseer cheek. It was removed with electrosurgery The wound was later grafted and the patient had no further trouble with the grafted area



Fig. 112

A. Patient had a papillomatous growth on the right side of the neck for three or four years that was irritated by his collar became inflamed around the border and began to grow as a papillomatous lesion which formed a partial collar around his neck In spite of its size, it was movable both vertically and horizontally Biopsy showed squamous cell carcinoma.

B. Photomicrograph groups and strands of epithelial cells with epithelial pearls. Moderate round cell infiltration and mitosis.



Fig. 113 Lesion treated with 6000 r with fair response Almost disappeared No nodes palpable Not cured however as operative removal of residual was refused.

in an apple-peach orchard Among his duties was *spraying* of the trees two or three times a year After each spraying the lupus vulgaris became aggravated. A definite squamous cell carcinoma developed in the lesion of the left

for several years. He refused to have all of the remaining scar and areas of lupus around the graft excised and grafted to prevent further carcinomas From time to time carcinomas developed requiring subsequent operations. Following an extensive exposure to the fruit tree spraying mixture the lupus surrounding the graft took on activity and grew all through the graft, ruining our painstaking surgical work The patient developed systemic lupus erythematosis and died

Syphilis is credited by some clinicians as being an etiological factor in causing epithelial malignancies of the skin as well as of the lips and oral cavity There were twenty-one cases in this group that had a positive serological test for syphilis and were treated for that disease for varying periods of time without an accurate biopsy diagnosis The associated malignancy was permitted to extend until widespread damage had been wrought It is obvious that any patient with syphilis, who also has a chronic ulcer in the skin or on the lips which does not respond promptly to

anti-syphilitic treatment, should have an adequate biopsy to determine the presence of malignancy

When a squamous cell carcinoma becomes infected the rate of growth is markedly accentuated and its radio-resistance increased, possibly due to the enhanced blood supply





Fig 114

A. Small ulceration developed in old scar on right temple of hairline, was irritated by brushing his hair Frequently bled and extended with attempted healing in one area only to break down in another There is a wide area of induration around the ulceration. Metastases to preauricular and upper carotid nodes.

B Photomicrograph shows strands of epithelial cells with marked anaplasia. Round cell infiltration Moderate mitoses.

ADENOCYSTIC (ADENOID) BASAL CELL EPITHELIOMA

Adenocystic basal cell epitheliomas frequently begin in seborrheic areas of the skin and form globular tumors which ulcerate undergo proliferation and after a period of time develop regional metastases. Hutchinson is credited with first describing them as "cratiform ulcers with malignant changes." Their origin is apparently from undeveloped sweat gland and hair follicle anlages These tumors are more malignant than the basal cell epitheliomas and grow quite rapidly, producing extensive destruction of the skin subcutaneous tissue and underlying bone, resulting in large hideous ulcers, and simulate squamous cell malignancies in their tendency to metastasize (Figs. 117 A and B 118 A, B and C, 119 A and B)



Fig 115 Lesion on right cheek began 6 months ago, following a slight ulceration, traumatic in character, developed a growing bulky tumor Biopsy revealed squamous cell carcinoma with metastases to the submaxillary lymph nodes.

CLINICAL BEHAVIOR

In making a careful follow up study of the 840 cases, (observed over a period of fifteen years) the patients were divided into two groups for evaluation of clinical behavior and determination of the results of therapy Cases that had had no treatment other than innocuous salves or ointments previous to consulting our clinics were designated as the primary group and those that had had previous treatment with x ray radium electrodesiccation or surgical excision, as the secondary group No case was reported that was not followed for at least a period of three

years Every means at our disposal was utilized to follow all cases, that is, to contact the patient a member of his family the refer ring physician or his family physician, the postmaster in the town in which the patient lived at the time he consulted the clinic and if the patient was elderly the bureau of vital statistics in the county or state was consulted There were 538 in the primary group who had no previous treatment other than salves or ointments Most of these 538 patients had their lesions less than two years and the lesion was less than 2 cm in diameter at the time they consulted the clinics This is in direct contrast to 302 in the secondary group who had had previous treatment Their lesions ac cording to the history had been present as a rule over two years and had been treated by x ray radium, electrodesiccation or local surgical excision or a combination of these

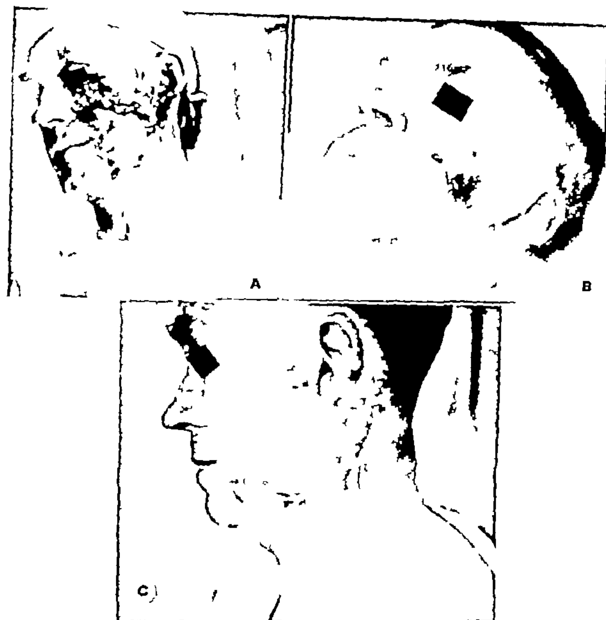


Fig 116

A. Lupus vulgaris involving the left side of the face and the upper part of the neck and ear A squamous cel carcinoma of low histological grade developed in the center

B Wound after electrosurgical removal and partial healing

C Wound grafted showing good results but some scars remaining around the edges Patient refused to have subsequent removal of other scars and plastic repairs

modalities. Eighteen of the squamous cell carcinomas in the secondary group had lymph node involvement on admission.

In the management of tumors in general it is imperative that the attending surgeon have definite knowledge of the lesion After a careful clinical evaluation of the patient, a biopsy is imperative It seems superfluous to stress this fact so many times, but only forty four patients of the 302 that had previous treatment gave a history of having had a biopsy It may be stressed again that accurate diagnosis far outweighs any theoretical danger of dissemination from removing pathologic tissue for microscopic examination Also, it should be remembered that the pathologist can only pass on the material submitted to him Therefore, adequate biopsy should include some of the base of the tumor and a portion of the edge where invasion of normal tissue can be observed. If the tumor is small



Fig. 117 Adenocystic basal cell epithelioma

A. Patient observed a firm nodule in front of left ear three years ago. Papillomatous growth has gradually enlarged and during the past four months, it has increased rapidly, become tender and painful. The top of it was irritated by shaving and ulcerated

B Photomicrograph. Nests of cells resembling basal cell carcinoma showing palisading of the outer groups of cells. A group of epithelial cells contain a cyst like structure Moderate round cell infiltration Some mitoses.



Fig 118. Adenocystic basal cell epithelioma

A. Patient developed a firm lesion below lobe of right ear six months ago The center was soft and felt like a cyst Incised elsewhere

B Scar following surgical excision no recurrence after five years.

C Photomicrograph shows nests and groups of epithelial cells some forming acini others palisading while still others occur in strands among connective tissue stroma.

it may be removed with biopsy forceps in its entirety and the bed proper destroyed with electrosurgery or irradiation to prevent recur



Fig 119 Sweat gland carcinoma

A. Patient developed cystic tumor in front of right ear 8 months previously. During the past two months became tender telangiectases developed over the summit of the tumor Surgical excision.

B Photomicrograph shows infiltration subcutaneous tissue with epithelial cells, some forming acini others occurring in small nests with palisading Marked lymphocytic infiltration. Moderate mitoses in some areas. In one area typical coil glands are present

rence Reference should be made to Chapter I for the technic of biopsy Careful examination should include an examination of the lymph node drainage area

TREATMENT

In planning therapy the general condition of the patient and the location and extent of the lesion must be considered Observation of Table III showing age of skin cancer patients reveals that many are in the older age group an important factor in determining the choice of treatment. It is imperative that the oncologist have at his command all the types of therapy needed for each particular patient. The results obtained will depend on how early the patient consults the oncologist and the adequacy of the treatment administered. Skin cancers diagnosed early are adequately treated with x ray electrosurgery surgery or radium or in the advanced stage by a combination of one or more of these modalities. It is not so much the type of irradiation or surgery which produces good results but the thoroughness of application. During the past twenty five years the results in our clinics have improved due to the fact that more patients are seen earlier and more intensive therapy either irradiation or radical surgery is utilized Too much stress cannot be laid on the axiom that skin malignancies are eradicated with the first treatment series, if such treatment is sufficient Inadequate therapy in the form of irradiation or surgery results in residual disease which continues to grow requiring a second third or even more treatments in *an attempt* to effect a cure It is imperative to remove or destroy every malignancy at the first seance or at the most the second Residual tumor cells become increasingly resistant with each application of irradiation or surgery and it has been shown not only in skin malignancies, but in malignancies in other areas of the body that inadequate treatment frequently accelerates the growth of the tumor Figi has long stressed this point and it has been our observation for many years Many lesions of the skin of the face neck and scalp may go on for one or two years and remain rather localized which would lead the lazy and incompetent to believe that they are innocuous, but in due time untreated skin malignancy will assert itself and destroy its host The treatment must be thorough and

no temporizing or half hearted therapy is of value

Treatment of the Primary Group of Carcinomas That Had no Previous Treatment

Early skin cancers are readily eradicated by x ray radium, electrosurgery or surgery, the important factor being to administer adequate treatment with a wide margin around the lesion. In the past, the application of escharotics, which usually consisted of nitric acid or zinc chloride paste, were used indiscriminately by quacks The escharotic therapist, being unscientific, treated all lesions of the skin without biopsy, or if a biopsy was done he was unable to interpret the findings. Cures were reported in many instances. More recently, Mohs (1941) established the dignity of escharotic destruction of skin cancers by a painstaking method, microscopically controlled He eradicates epithelial skin malignancies, plane by plane until all traces of the tumor are gone. He reports very good results in a sizeable group of skin malignancies. We have had no experience with the method

Electrosurgical or surgical excision should extend deep enough to remove the tumor entirely including a safe margin of normal tissue around and beneath it (1 5–2 cm) (Fig 120 A–D)

Lesions under 2 cm in diameter and on any area of the face and neck other than the eye lids are controlled in most instances by irradiation. Our plan of treatment consists of giving 4000–4500 r for basal cell carcinomas and 5500–6000 r for squamous cell carcinomas and adenocystic basal cell epitheliomas, distributed over three or four sittings usually spaced at two or three day intervals. X ray therapy is given through a cone sufficient in size to allow one half to one centimeter margin Our results substantiate our belief that the broken dose method is better than one massive dose of 3000 or 4000 r When it is appreciated that cancer cells divide two to four times daily depending upon their degree of cellular differentiation the division of the total treatment into several sessions will destroy cells in the third or fourth that are not eradicated in the first or second treatment (Coutard) The resulting marked erythema or blistering persists from a few days to three or four weeks. When irradiation is given by x ray, a more even distribution of the beam over the entire tumor is obtained than with the use of radium However, the lesion can be adequately treated

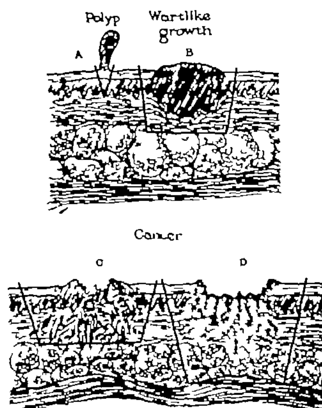


Fig. 120

A. Surgical excision of polyp V-shaped excision with adequate margin around base. The excision extending through the thickness of the skin.

B Excision of wart like growth. Excision should give a safe margin around and beneath the tumor

C. Incorrect method of removing small malignant epithelial tumors of the skin The incision does not give adequate margin around the tumor or beneath it.

D Correct method of excision of skin malignancies. An adequate margin is given around and beneath the tumor (Courtesy Surgical Treatment of the Soft Tissue, Bancroft and Humphreys. J P Lippincott Co 1946.)

with radium if desired usually giving 8–10 T.E.D for basal cell carcinomas and 10–12 T E.D for squamous cell carcinomas and adenocystic basal cell epitheliomas Small lesions are completely eradicated with electrodesiccation, electrocoagulation or surgical excision if a sufficient margin is given well around and below the tumor

Cancers over 2.5 cm. in diameter frequently have infiltrated the entire thickness of the

skin and extended into the subcutaneous tissue or in many instances the muscles. These larger growths are treated with irradiation or surgical excision followed by skin *grafting when indicated*. When such lesions are eradicated with adequate irradiation, ugly *scars frequently* result, which may break down producing a chronic *ulcer that is reluctant to heal, necessitating* wide surgical *excision with appropriate* grafting, usually a pedicle graft. Wide experience is essential in deciding between irradiation and surgical excision with plastic repair. The choice often depends on the location of the tumor, the age of the patient, and the cosmetic results desired.



Fig. 121. Basal cell carcinoma, tarsal border right lower eyelid. Biopsy: basal cell carcinoma. Lesion thoroughly removed with electrodesiccation. No recurrence at end of five years.



Fig. 122. Squamous cell carcinoma, outer canthus lower left eyelid. History of two months duration. Treated as a stye by being lanced on two occasions. Biopsy: squamous cell carcinoma. Removed with electrocoagulation. No recurrence after three years.

Carcinomas *of the eyelids* present specific technical problems of therapy because of their proximity to the eye and their frequent rapid *rate of growth*, calling for skill and ingenuity in the selection and application of a proper therapeutic modality.



Fig. 123.

A. Basal cell carcinoma, left upper eyelid, one year's duration. Thoroughly removed with electrodesiccation; no recurrence.

B. Photomicrograph showing infiltration of epithelial cells in nests and strands. Cells show palisading.

Basal cell carcinomas more frequently involve the eyelids than squamous cell or adenocystic types; they are indolent and slow in growth unless they cross the tarsal surface to involve the conjunctiva, when rapid growth ensues. An incompletely removed basal cell carcinoma often changes to squamous cell

carcinoma The tarsal border is more commonly affected with the squamous cell cancer

Either basal cell or squamous cell carcinomas involving the tarsal border of the lid are best removed with electrodesiccation If the lesion is small, it can be removed with biopsy forceps and the base thoroughly destroyed with electrodesiccation leaving a minimum of scarring and loss of cilia, without injury to the eye, or loss of function of the lid (Fig 121) Occasionally a squamous cell carcinoma involves the tarsal border of the lid and presents itself as a localized red swelling being lanced and treated erroneously as a stye. Any lesion that persists longer than two or three weeks requires a biopsy to determine its true nature Fig 122 illustrates just such a patient. Two months previously he developed what was apparently a stye on the lower lid of the left eye. It had been incised twice prior to registering in the clinic. Biopsy revealed squamous cell carcinoma.

Small basal cell or squamous cell carcinomas on the eyelid proper away from the tarsal plate are also best removed with electrodesiccation which leaves a minimum of scarring and good function of the lid. The skin around the base and the adjacent conjunctiva is injected with one per cent procaine solution. When so destroyed, such tumors seldom recur (Fig 123 A and B and Fig 124 A and B) It is astonishing to watch the slow healing by granulation gradually pull the skin edges together at the same time stretching the nearby skin so that no ectropion occurs.

Cancers of the eyelids may be eradicated with irradiation by x ray or radium if the eye is carefully protected with a lead or gold shield dipped in wax and placed in the cocainized conjunctival sac beneath the lids. Scattered irradiation may produce a cataract which appears after a period of months or years. This has been stressed by Vilray Blair and others If the lesion is 1 cm in diameter or less, little scarring is produced with good functional results (Fig 125 A, B and C) Larger tumors are also destroyed by irradiation but the scar is avascular and contracts with varying deformities the cilia are destroyed at a distance from the growth, with consequent lessened protection to the eye Specially designed B-ray radium applicators are used for destroying epitheliomas extending onto the conjunctival lining of the lids with good results in some cases

Growths having their origin on the inner or outer third of the lid may extend if untreated, around the canthus to involve the other lid Such cancers when treated adequately often result in scarring and contraction of the lids, producing the typical slit-eye appearance at times necessitating cosmetic repair Patient shown in Fig 126 A and B did not require repair



Fig. 124

A. Basal cell carcinoma, inner canthus right eye 8 months' duration Lesion electrodesiccated under local anesthesia.

B Good cosmetic results with no loss of function of the lids. No recurrence after three years. No loss of cilia as would be the case following irradiation.

Cancers involving the internal or external canthi require special treatment They may extend to the conjunctiva early or grow into the orbit alongside the eyeball Those located

skin and extended into the subcutaneous tissue or in many instances, the muscles. These larger growths are treated with irradiation or surgical excision followed by skin grafting when indicated. When such lesions are eradicated with adequate irradiation ugly scars frequently

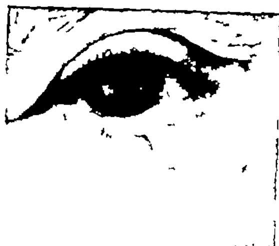


Fig. 121 Basal cell carcinoma, tarsal border, right lower eyelid Biopsy basal cell carcinoma. Lesion thoroughly removed with electrodesiccation. No recurrence at end of five years.



Fig 122. Squamous cell carcinoma outer canthus, lower left eyelid. History of two months duration. Treated as a stye by being lanced on two occasions. Biopsy squamous cell carcinoma. Removed with electrocoagulation No recurrence after three years.

result which may break down producing a chronic ulcer that is reluctant to heal, necessitating wide surgical excision with appropriate grafting usually a pedicle graft Wide experience is essential in deciding between irradiation and surgical excision with plastic repair The choice often depends on the location of the tumor the age of the patient, and the cosmetic results desired.

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Fig 123

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B Photomicrograph showing infiltration of epithelial cells in nests and strands. Cells show palisading.

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carcinoma. The tarsal border is more commonly affected with the squamous cell cancer

Either basal cell or squamous cell carcinomas involving the tarsal border of the lid are best removed with electrodesiccation. If the lesion is small, it can be removed with biopsy forceps and the base thoroughly destroyed with electrodesiccation leaving a minimum of scarring and loss of cilia without injury to the eye or loss of function of the lid (Fig 121) Occasionally a squamous cell carcinoma involves the tarsal border of the lid and presents itself as a localized red swelling, being lanced and treated erroneously as a stye Any lesion that persists longer than two or three weeks requires a biopsy to determine its true nature Fig 122 illustrates just such a patient. Two months previously he developed what was apparently a stye on the lower lid of the left eye. It had been incised twice prior to registering in the clinic. Biopsy revealed squamous cell carcinoma.

Small basal cell or squamous cell carcinomas on the eyelid proper away from the tarsal plate are also best removed with electrodesiccation, which leaves a minimum of scarring and good function of the lid. The skin around the base and the adjacent conjunctiva is injected with one per cent procaine solution. When so destroyed, such tumors seldom recur (Fig 123 A and B and Fig 124 A and B) It is astonishing to watch the slow healing by granulation gradually pull the skin edges together at the same time stretching the nearby skin so that no ectropion occurs

Cancers of the eyelids may be eradicated with irradiation by x ray or radium if the eye is carefully protected with a lead or gold shield dipped in wax and placed in the cocainized conjunctival sac beneath the lids. Scattered irradiation may produce a cataract which appears after a period of months or years. This has been stressed by Vilray Blair and others If the lesion is 1 cm in diameter or less, little scarring is produced with good functional results (Fig 125 A B and C) Larger tumors are also destroyed by irradiation but the scar is avascular and contracts with varying deformities, the cilia are destroyed at a distance from the growth, with consequent lessened protection to the eye. Specially designed B ray radium applicators are used for destroying epitheliomas extending onto the conjunctival lining of the lids with good results in some cases

Growths having their origin on the inner or outer third of the lid may extend, if untreated, around the canthus to involve the



Fig. 124

A. Basal cell carcinoma, inner canthus right eye, 8 months' duration. Lesion electrodesiccated under local anesthesia.

B Good cosmetic results with no loss of function of the lids. No recurrence after three years. No loss of cilia as would be the case following irradiation.

other lid Such cancers, when treated adequately often result in scarring and contraction of the lids, producing the typical slit-eye appearance at times necessitating cosmetic repair Patient shown in Fig 126 A and B did not require repair

Cancers involving the internal or external canthi require special treatment They may extend to the conjunctiva early or grow into the orbit alongside the eyeball. Those located

on the internal canthus may extend to the lacrimal duct and spread rapidly by that route These canthal tumors are best treated by electrodesiccation or electrocoagulation under local electrosurgery care being exercised to follow all the ramifications of the tumor which may extend beside the eyeball or into the lacrimal apparatus (Fig 127 A, B C D)



Fig. 125

A. Basal cell carcinoma lower eyelid present two years. Tumor involves the depth of the lower lid. Removed with irradiation after properly protecting the eye with lead shield.
B Photomicrograph shows adenocystic basal cell epithelioma.
C Good functional and cosmetic results. No recurrence after five years. Note loss of cilia of lower lid—avoidable in smaller lesions with electrodesiccation.

anesthesia. Care must be exercised to circumvallate the growth by a wide margin in the normal skin and to follow it into the orbit or nasal cavity if necessary

Lesions that persist following irradiation therapy should be thoroughly removed with

Skin cancers on the ear present a few special problems in treatment The covering of the ear is thin with little subcutaneous tissue the blood supply is not as adequate as over other areas of the face and the irregularity of the contour of the ear makes accurate irradiation

difficult. The rim of the ear is frequently the seat of premalignant lesions, as senile warts and keratoses which should be removed before they undergo malignant transformation Cancers having their origin in the auditory canal, or those that develop in the concha and extend into the canal, are much more serious than those located on other areas They may begin as a chronic eczematoid or erisipeloid like condition with areas that go on to ulceration and definite cancer Such lesions, due to their rapid growth when the canal is involved and consequent difficulty in eradicating them may extend into the cranium. Severe pain is frequent.

Lesions involving the auditory canal may be treated with intensive irradiation usually 6000–7000 r given through three ports, one directly over the canal, the other two anterior and posterior and directed at an angle toward the canal Radium tubes may be inserted into the canal, and 800–1000 mgm hours of treatment added to the x ray therapy This amount of irradiation may not control the lesion (Fig 128 A, B and C) Then the most rational treatment is to completely remove the ear and clean out the canal with electrosurgery The defect is later covered with an appropriate pedicle or split thickness skin graft. Most patients will not permit such a drastic procedure until the tumor has already entered the canal and is practically in an incurable state If the external ear is not involved by the cancer, it is turned back, the growth removed, and the ear resutured in approximately normal position with little disfigurement (see Chapter XV)

Treatment of carcinomas over the cartilage of the ear has been the subject of controversy for many years It is contended by some clinical observers that irradiation produces destruction of cartilage This has not been our experience in treating small primary cancers over the cartilage of the ear and nose when the irradiation is properly given Malignancy over *the cartilage bearing area of the* ear should be evaluated to determine whether there is involvement of the cartilage before treatment is instituted This can be determined frequently by observing the skin on the opposite side of the ear from the tumor, if the cartilage is involved, there will be redness, edema and puckering of the skin due to extension of the cancer through the cartilage



Fig 126. Squamous cell carcinoma, upper eyelid
A. Squamous cell carcinoma beginning on the outer half of right upper eyelid and extending around the external canthus to the lower eyelid
B Good cosmetic and functional results following removal with electrocoagulation

Growths over cartilage in general require more intensive irradiation during the first course of the treatment than lesions over more vascular areas. Basal cell carcinoma, as a rule should have 5000 r and squamous cell lesions 6000–6500 r Healing is slower than over other areas of the skin of the face and neck, but is excellent in the majority following proper therapy Our observation is that

destruction of cartilage results, in most instances, from inadequate irradiation repeated over a long period of time. Patients with large lesions should be informed that following sufficient irradiation to effect a cure there may result at a later date a breakdown of the cartilage If such cartilage necrosis should develop, electrosurgical or surgical removal is indicated Our percentages of late breakdown of the cartilage were extremely low in patients who came without previous treatment.

Small lesions on the ear may be treated by surgical excision A superficial cancer may be removed with the scalpel down to the perichondrium, followed by a graft to cover the raw surface A graft should not be placed directly on the cartilage but will take if perichondrium can be left over the cartilage

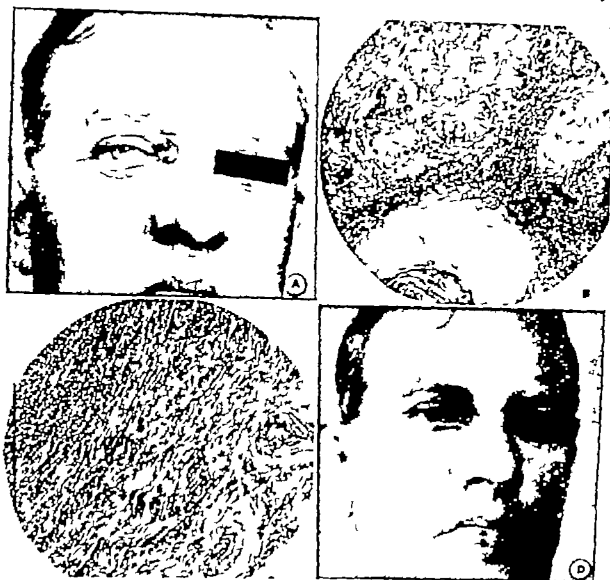


Fig 127 Squamous cell carcinoma persisting following irradiation

A. Squamous cell carcinoma involving inner canthus right eye. Treated with x-ray 2500 r elsewhere Excised with electrosurgery care being taken to remove ramifications of tumor into orbit beside the eyeball

B Photomicrograph shows persistence of tumor Epithelial cells partially destroyed by previous irradiation—other cells viable. Round cell infiltration. Epithelial pearl.

C. Area of tumor that was destroyed by irradiation therapy showing chronic inflammation scarring, obliterating endarteritis.

D Good cosmetic and functional results with no recurrence after five years

Again, the skin of one side of the ear and the cartilage—both may be involved After removal of the skin and cartilage, a graft is applied to the remaining normal skin of the over the remaining cartilage and skin When large areas of the skin must be removed to eradicate the tumor, and at times areas of the cartilage the defect may be closed with



Fig 128. Squamous cell carcinoma, auditory canal

A. Treated with radium later with x ray and electrosurgery

B Lateral view several years later showing extensive destruction of the ear a narrowing and lengthening *of the auditory canal paralysis of facial muscles* on the left side due to destruction of the facial nerve.

C The left eyelids have been partially sutured together to prevent corneal ulcer resulting from destruction of orbital branches of facial nerve. No recurrence ten years.

opposite side without leaving a hole or other defect in the ear At times the involved skin and half the thickness of the cartilage requires electrosurgical eradication without damage to the skin of the opposite side It is surprising in these cases to watch granulation and healing a wide base pedicle graft from the mastoid area Cancers developing from keratoses may involve both sides of the ear at the same time. When such growths are treated with adequate irradiation the cartilage may be injured, resulting in a painful ulceration Then a wedge-shaped

excision of the involved area will make the ear smaller with little disfigurement The primary purpose is to cure the patient (Fig 129)

Electrosurgery is of great value in removing cancers from the external ear Under local injection anesthesia, small lesions are destroyed by electrodesiccation large growths are resected with an electrotome (see Chapt. I) Healing over cartilage is fairly rapid following electrosurgery and scars are not disfiguring Results following electrosurgical removal of cancers 1–2½ cm in diameter from the anterior



Fig. 129 Basal cell carcinoma developing in hyperkeratotic areas on the anterior and posterior surface of the left ear Treated with irradiation Later breakdown of cartilage which was excised by V-shaped excision. Good functional results. Note hyperkeratoses on rim of the ear

or posterior surface of the external ear have been remarkably satisfactory in our hands

Lesions involving the lobes, because of their better blood supply and absence of cartilage respond favorably to adequate radiation therapy Tumors having origin at the junction of the lobe and cheek may extend around the angle causing a deep fissure between the lobe and the face. Adequate treatment results in a destruction of the tip of the lobe which does *not* alter the appearance of the ear to any great extent (Fig 130 A, B C)

Cancers developing on the posterior surface of the ear and extending to the scalp invade the deeper structures rapidly if located at *the inferior margin* they may involve the facial nerve with resultant paralysis (Fig. 131 A, B C)

Carcinoma on the nose requires careful speculum examination of the interior of the nose to determine whether the lesion has extended through the cartilage to involve the mucous membrane. The soft tissues are somewhat thicker and the blood supply more abundant over the nose than over the ear there is less likelihood of producing damage to the nasal cartilage by irradiation On the other hand, if the lesion extends around the ala to enter the nasal cavity or penetrates the cartilage directly to involve the mucous membrane, there is rapid extension of the growth with probable involvement of the nasal sinuses.

Small early lesions located *on the nose* are treated similar to those on the face and neck with x ray therapy giving 4000–4500 r to the basal cell carcinoma and 5500–6000 r for the squamous cell carcinoma and adenocystic basal cell epithelioma (Fig 132 A and B)

Larger growths are treated either with irradiation or electrosurgery disfiguring defects, require *plastic repair later* (Fig 133 A, B C)

Cancers located on the nose extending to *the mucous membrane should be surgically or* electrosurgically excised to determine accurately extension into the nose or adjacent *sinuses. The resulting defect is closed by a* pedicle graft from the forehead or the cheek immediately or at a later date (Fig 134 A and B)

To insure proper management of malignancies, biopsy should be taken and treatment instituted *appropriate to the particular type* This is well represented by the patient shown in Figure 135 A and B who had a basal cell carcinoma on the nose *of two years duration* a squamous cell carcinoma on the skin of the lower lip and an adenocystic basal cell epithelioma on *the medial side of the left* upper eyelid The basal cell epithelioma and squamous cell carcinoma were eradicated with 4500 and 6000 r respectively and *the adeno-*

cystic basal cell epithelioma on the eyelid destroyed with electrodesiccation.

deeply to involve the subcutaneous tissue when eradicated with adequate x ray therapy,

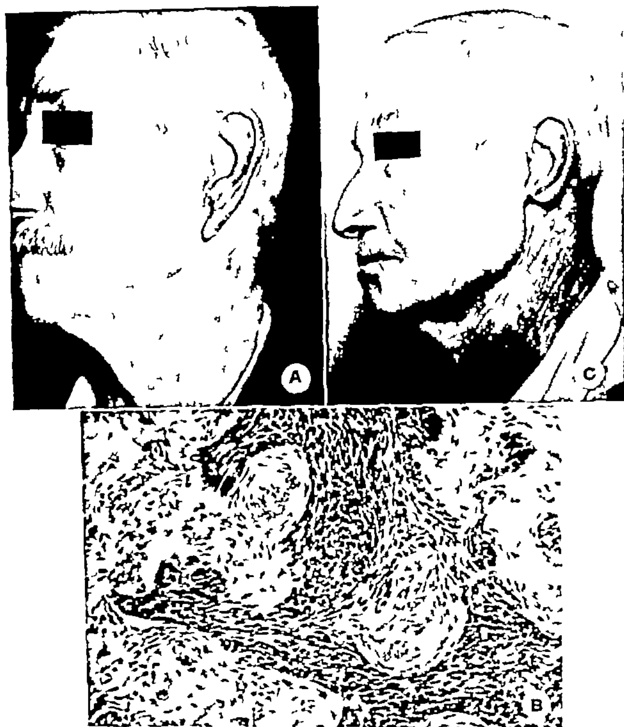


Fig. 130. Squamous cell carcinoma lobe left ear

A. Squamous cell carcinoma, 6 months' duration, penetrating the lobe of left ear

B. Photomicrograph showing epithelial cells occurring in strands and nests. Cells varying in size shape and chromaticity Round cell infiltration.

C. Results following x ray treatment 6000 r

Carcinomas on the temples zygomatic areas of the cheeks, or in front of the ear 2 cm in diameter or larger which have penetrated

result in thin ischemic scars which tend to break down forming superficial ulcerations and later contractions, and when close to the

eye may produce partial loss of function of the lids (Fig 136, A B C) These radiation scars

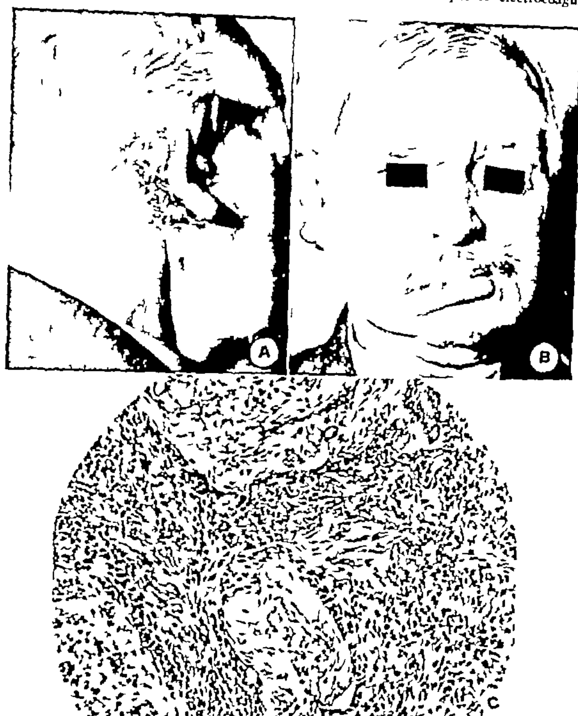


Fig. 131 Squamous cell carcinoma, posterior area of ear

A. Squamous cell carcinoma beginning on posterior-inferior border of the ear and extending onto scalp

B Paralysis of facial muscles on the right side as a result of involvement of facial nerve

C. Photomicrograph showing strands of squamous epithelium with irregular sized cells with deeply staining nuclei and attempting pearl formation

sooner or later require excision and repair of the defect with a split thickness or pedicle graft It is better practice then to remove large lesions of the temple in the first place, either with the scalpel or electrocoagulation and cover the resulting defect with immediate or delayed graft (Fig 137 A B Fig 138 A B C)

Cancers of the skin of the lips. Small early lesions are eradicated with irradiation or surgery (Fig 139, A, B, Fig 140 A, B) When permitted to extend onto the vermilion border of the lip or the mucous membrane of the nose rapid growth ensues with increased difficulty of cure Involvement of the entire thickness of the lip requires wide surgical excision with plastic repair (Fig 141 A, B) See Chapter VI

The eradication of premalignant lesions cannot be too strongly urged the type of therapy instituted must take care of the case at hand Figure 142 A and B illustrates such a problem The patient had extensive lupus vulgaris involving the right cheek lobe of the right ear and extending onto the neck. Ulceration developed repeatedly Since such areas frequently are the seat of squamous carcinoma they must be removed by surgical excision and closed by appropriate plastic operations.

Basal cell carcinomas in the *normal creases of the skin* infiltrate deeply the skin seems to fold over itself often obscuring the nature and depth of the disease (Fig 143) These fissure-like cancers are best treated by wide and deep surgical excision and appropriate plastic repair if necessary



Fig 132. Basal cell carcinoma involving the ala of the nose
A. The lesion had not extended to involve the cartilage or the mucous membrane.
B Eradication with 5000 r irradiation Good cosmetic results.

Analysis of 538 Cases with Primary Malignancies of the Skin

As previously mentioned the study of cases that have been treated in our clinics from January, 1930 to July, 1945 were divided into (1) those that had had no previous treatment other than innocuous salves and ointments, and (2) those that had been treated over a period of time with x ray, radium electrosurgery or surgery, with recurrence or more accurately persistence of the disease This statistical analysis is based on patients whose diagnosis was proven by pathological study All cases reported have been followed for a period of three to eighteen years. One hundred thirty four patients were not included as they disappeared after the initial treatment or were only followed for a few months, the results of their therapy being unknown. Four hundred four of the group of 538 have been followed adequately to date In general this group of patients came in the early stage of their disease the lesion being present for less than two years and was less than 2 cm in diameter The results of therapy are outlined in the following tables 5 6 7 8

There were 321 basal cell carcinomas 290 were treated with radiation therapy Two hundred eighty or 96.5 per cent, have re-

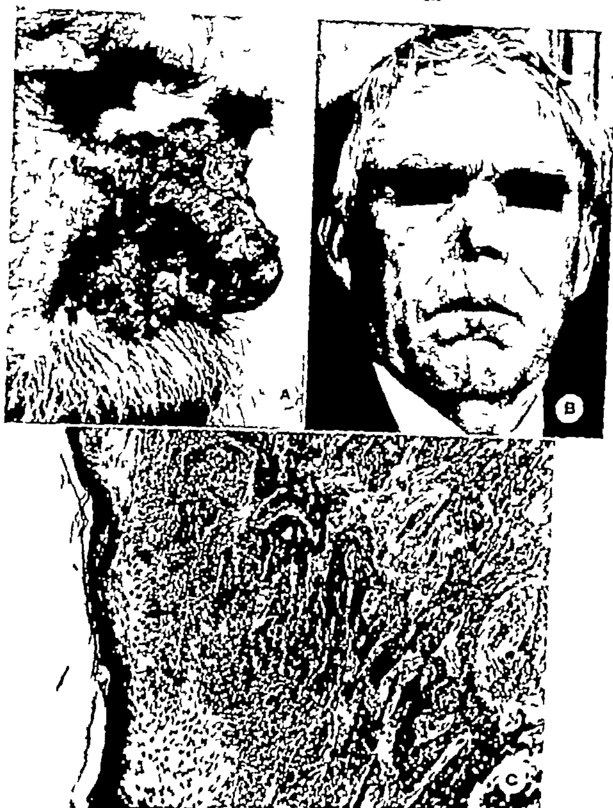


Fig 133 Basal cell carcinoma nose and cheek

A Basal cell carcinoma involving the right side of the nose and extending onto cheek

B Resulting defect following irradiation therapy Such defects require plastic repair

C. Photomicrograph showing invasion with epithelial cells varying in size shape and chromaticity Group of cells showing palisading

mained free from disease from three to eight een years Ten or 3.5 per cent developed a recurrence that was treated successfully by surgical measures. Thirty-one cases of basal



Fig. 134 Basal cell carcinoma ala nose penetrated cartilage

A. Lesion involving ala of the nose on the right side of one year's duration. Examination revealed involvement of the mucous membrane. Biopsy basal cell carcinoma with squamous cell changes. The lesion was widely excised, pedicle graft from forehead, that had been lined with split thickness graft to form the lining of the nasal cavity

B Cosmetic results. No recurrence after 5 years.



Fig 135 Patient had three different types of carcinoma on face at the same time

A. Basal cell carcinoma tip of nose 2 years duration. Squamous cell carcinoma of the skin of lower lip 6 months duration. Adenocystic basal cell epithelioma arising from senile wart, inner canthus of left eye All lesions proved by biopsy

B Lesion on nose treated with 4500 r x ray Squamous cell carcinoma on lower lip eradicated with 6000 r x-ray Adenocystic basal cell epithelioma on inner canthus of left eye removed with electrocoagulation. Wound is not healed at the time of this photograph. No recurrences four years later

cell carcinoma were treated with electrosurgery or surgical excision The size, location and ex irradiation There were no recurrences in this group of thirty-one cases.

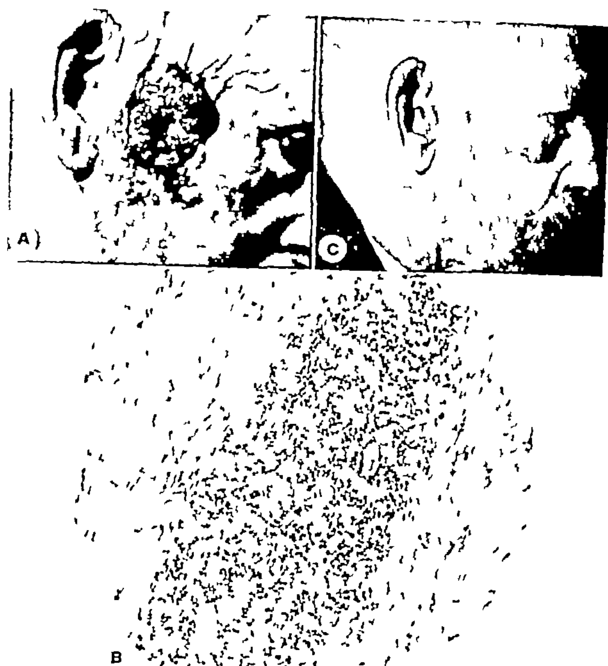


Fig. 136

A. Basal cell carcinoma, right cheek, persisting after x ray therapy Lesion was implanted with radium needles with permanent healing. Note strings attached to needles

B Photomicrograph of biopsy after treatment with x ray therapy elsewhere showing persistence of basal cell epithelioma. Nests of epithelial cells in fibrous connective tissue

C. Resultant scar following eradication of tumor with radium Such scars are tender and easily traumatized Should be surgically excised with appropriate graft

tension of the tumor beneath the skin were the factors determining that electrosurgery or surgery would eradicate the growth better and with a more satisfactory cosmetic result than

There were fifty two patients with squamous cell carcinoma that had no previous treatment Twenty six of these were treated with x ray therapy with nine recurring or 38 per cent

The recurrences were treated by surgical excision and grafting when necessary with no patients most of whom had larger lesions were treated with electrosurgical or surgical excision



Fig 137

A. Basal cell carcinoma involving left temple of 2 years duration that had infiltrated into the subcutaneous tissue Eradicated with 4500 r, x ray

B Resultant contracture. Such scars are easily traumatized Slight functional disturbance of the left eyelids.



Fig 138. Basal cell carcinoma right temple

A. Basal cell epithelioma right cheek in front of ear of two years duration

B Lesion eradicated with irradiation leaving thin avascular scar

C There was a breakdown of the scar due to fibrosis and endarteritis. Scar excised with appropriate graft. No recurrence after ten years.

local recurrence One patient developed local and distant metastases from which he died after extensive block dissection Twenty-six with one recurrence We feel that squamous cell carcinomas over 1 5–2 cm in diameter are best treated by surgical measures i e. wide

scalpel or electrosurgical excision Four patients with squamous cell carcinoma developed



Fig. 139

A. Basal cell carcinoma of skin of right upper lip developing from senile wart Irritated by shaving
B Eradicated with 4500 r x-ray with good cosmetic results. No recurrence after three years.



Fig. 140

A. Basal cell carcinoma of skin of upper lip developed from a benign papilloma.
B Lesion eradicated with 4500 r x-ray with only a slight scar remaining

regional lymph node metastases, requiring radical block dissection of the neck

There were thirty-one patients with adenocystic basal cell epithelioma or sweat gland carcinoma of which seventeen were treated with electrosurgical or surgical excision one recurred Fourteen were treated with x ray therapy four developed local recurrence None of these patients developed local or distant metastases. The recurrences were treated with wide surgical excision and were grafted when indicated To date all have remained free from



Fig 141

A. Basal cell carcinoma of skin of upper lip involving the entire thickness of the lip but not extending to involve the vermilion border or nares persisting after inadequate x ray therapy which had extended over a period of several years.

B Involved area of lip was excised *en bloc* removing a rectantular area of tissue A horizontal incision was extended on each side into the cheek, permitting closure of the defect. The upper lip is slightly shorter than the lower

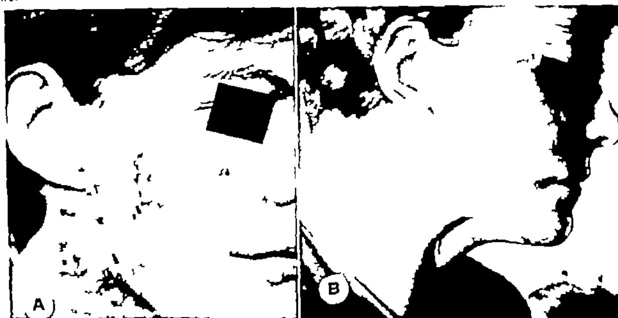


Fig. 142

A. Lupus vulgaris involving right cheek, lobe of right ear and extending to the right side of the neck. Recurrent ulceration in some areas constantly Such ulcerated areas frequently undergo malignant transformation

B Surgical excision with appropriate skin graft will prevent the development of carcinoma and improve the cosmetic appearance of the patient.

disease It is readily appreciated that adenocystic basal cell epitheliomas are best treated with surgical excision to prevent a recurrence which follows in 28.8 per cent treated with irradiation

Treatment of Secondary Group that had had Previous Treatment

Radiation therapy is often continued to an unhealed area over a period of months, and even years without a biopsy being taken the



Fig. 143 Basal cell carcinoma occurring in the crease below the left eye producing fissure type of cancer. Such lesions infiltrate the underlying tissues rather deeply requiring intensive therapy or wide excision and appropriate repair

TABLE 5

538 Cases That Had No Previous Therapy

	Basal Cell	Squamous Cell	Adenocystic	Total
Total Cases	423	72	43	538
Indeterminate group were unable to follow	102	20	12	134
Total number studied	321	52	31	404

TABLE 6

Our Treatment of 404 Primary Cases

	Basal Cell	Squamous Cell	Adenocystic	Total
Total number studied	321	52	31	404
Number treated by irradiation	290	26	14	330
Number that were treated with electrosurgery or wide surgical excision and plastic procedures when necessary	31	26	17	74

assumption being that cancer still remains. Such treatment is strictly unscientific. When cancer is present it is resistant to further irradiation if the ulcer represents a broken-down scar from obliterating endarteritis and fibrosis further radiation only serves to aggravate the condition. Adequate biopsy is a guide for intelligent therapy If the biopsy reveals persistent or recurrent growth or a broken-down scar wide excision with plastic repair is required (Fig 144) It is an axiom in the treatment of skin malignancy that no worthwhile purpose is served by re-radiation of secondary break

TABLE 7

Results of Irradiation Therapy of 330 Primary Cases

	Basal Cell	Squamous Cell	Adenocystic	Total
Number that had x ray therapy	290	26	14	330
Primary lesions healed	280 (96.5%)	17 (61.5%)	10 (71.2%)	306 (92%)

TABLE 8

Results of Surgery of 74 Primary Cases and 26 Recurrent Cases

	Basal Cell	Squamous Cell	Adenocystic	Total
A. Number that were treated with electrosurgery or wide surgical excision and plastic procedures when necessary	31	26	17	74
Primary lesions healed	31 100%	25 96%	16 94%	72–97%
Recurrence following surgery	0	1 4%	1 6%	2–3%
B. Total number of recurrences	10 3.5%	11 21%	5 16%	26–6.4%
Number that developed metastases to regional lymph nodes following initial therapy	0	5 9.6%	0	5 7.7%
Successful treatment of recurrences by surgical measures	10–100%	10 90%	5 100%	25 96%
Deaths from disease	0	1 4%	0	1–1.3%



Fig 144 Patient had basal cell carcinoma on the right posterior surface of the neck treated with x ray Recurred two years later was again treated with x ray Lesion recurred one year later and was again treated with x ray When examined in clinic, an ulcerated area was present. Biopsy revealed broken-down scar marked fibrosis, endarteritis. No evidence of malignancy Patient refused excision and graft. 1½ years later patient returned with large growth biopsy squamous cell carcinoma. Refused surgical excision.

Cancer of the skin of the nose inadequately treated continues to destroy part or all of the nose, and must have all of the remaining disease removed before reconstruction is started Such growths are resistant to further irradiation and are best destroyed with electrosurgery The patient is often toxic and emaciated from the absorption of infected necrotic tissue, well represented in Figure 145 A and B The patient with basal cell epithelioma of the nose was inadequately treated with x ray and radium, until the nose was destroyed and the sinuses invaded The remaining cancer was removed with electrosurgery After healing a prosthetic plate was used for the roof of the mouth permitting the patient to eat He gained forty five pounds in seven months and returned to his occupation Several months later he died from extension into orbit

Patients with skin malignancy as well as malignancy in other areas of the body should be examined carefully at regular intervals to determine the presence of local recurrence,





Fig. 145

A Squamous carcinoma developing in the ala of the nose on the left side Inadequately treated with x ray and radium It eventually destroyed the nose nasal septum and extended into the sinuses. Removed widely with electrosurgery

B 11 months later the lesion was controlled. The patient wore a dental prosthesis, permitting him to eat properly Has gained 45 pounds in weight, wears a nasal prosthesis attached to spectacle rims. Died several months later with extension into orbit

down irradiation scars or to re radiate skin lesions that have failed to heal after the first or second series of treatments

regional or distant metastases. This is further stressed if the primary lesion is either a squamous cell carcinoma or adenocystic basal cell

epithelioma (Fig 146 A B C) The patient was treated elsewhere with irradiation for a squamous cell carcinoma of the ala of the nose His physician and dentist treated the pain as an infection of the mandible by extracting the second and third molar teeth Later a swelling

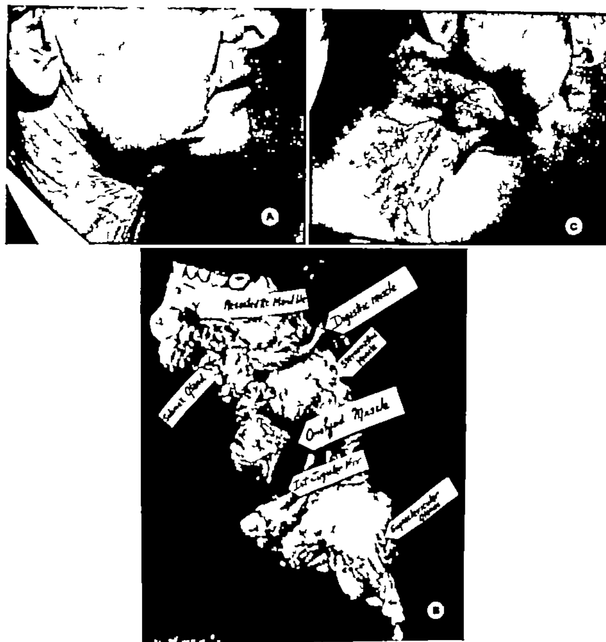


Fig. 146. Squamous cell carcinoma, ala right side of nose

A. Treated with irradiation elsewhere four years previously without biopsy One year ago developed pain in right mandible and had two teeth extracted Developed mass in right submaxillary area which was treated along with diseased mandible with x-ray therapy without biopsy When seen in clinic an ulcer was present over the most prominent part of the mass. \ ray examination showed metastatic mass involving ramus of the mandible There was no primary growth in mouth.

B Resected specimen showing involved mandible submaxillary gland, lymph-bearing structure and nodes, sternomastoid muscle

C. Wound ten days after resection of mandible and radical neck dissection with plastic repair Recurrence in floor of mouth several months later

the primary lesion healing with a defect of the ala. Four years later he developed pain in the right mandible in the area of the molar teeth developed in the right submaxillary gland and involved the mandible After irradiation ther apy a sinus developed in the skin over the sub-

maxillary gland The patient, when examined, had a healed deformity of the right ala of the nose and a firm mass in the right submaxillary triangle ulcerating through the skin Biopsy revealed *squamous* cell carcinoma. Roentgenograph of the mandible showed localized destruction by malignancy A composite operation consisting of a radical neck dissection and resection of the involved area of the *mandible* was done with good primary result. Several months later he returned with recurrence far back in the mouth

When cases require resection of the maxilla or mandible, a dental prosthesis is prepared before operation, and put in place at the completion of the operation preventing the jaw from being pulled out of alignment and assisting in mastication The deformity in the mandible is often later restored with a bone graft from a rib or crest of ilium A period of six months allows observation for any latent infection or recurrence of the tumor (Chapter XXI)

Patients with skin cancer that have had previous treatment offer many varied problems. In the group of 840 cases that we evaluated 302 had received therapy before they consulted our clinics. These patients gave a *history of having had their disease for* a period of from two to fifteen years or longer Most of the lesions were over 3 cm. in diameter Various modalities of therapy had been used escharotics, radium x ray electrosurgery, surgery or a combination of one or more An endeavor was made in many instances to determine from the patients physicians how much x ray or radium therapy was given and over how long a period of time. When information was obtained frequently it was found that only 100–1000 r had been administered over a period of a few weeks or months or in some instances, over a period of years. Small inefficient applications of x ray or radium repeated indefinitely serve only to make the cancer tolerant to irradiation When the cancer is located over the cartilage of the ear or nose, the repeated radiation produces destruction of the cartilage. The histories revealed frequently that the disease had persisted throughout the treatment or had recurred within a short time, weeks or months

When these patients were first examined in the clinics eight had radio-osteo-necrosis of the maxilla or mandible, six others had extension of the disease into the mandible or maxilla necessitating resection of the involved bone, eleven had extensive involvement of the nose *and in two, the entire nose was destroyed*, seven patients had an extensive defect of the ear two had the entire ear destroyed Eighteen patients with squamous cell carcinoma had metastases to the regional lymph nodes while six others had an extension of the malignancy from the eyelids to the eye, necessitating enucleation

Each year a number of patients present themselves with ulcerating scars following treatment with x ray or radium, often complaining that the ulcerating scar is the result of the therapy Biopsy frequently reveals persistent malignancy, indicative of insufficient irradiation therapy Care and time are utilized to explain to such patients that death rarely occurs from an ulcer of the skin resulting from x ray or radium treatment but all too frequently death occurs from uncontrolled cancer *When there is delayed healing or when an irra*diation scar breaks down, repeated biopsy must be the guide for effective treatment The two conditions that produce delayed healing are a persistence of the cancer and ischemia of the tissues, resulting from sclerosis and obliterating endarteritis, produced by irradiation therapy

ANALYSIS OF 302 CASES WITH SECONDARY MALIGNANCIES OF THE SKIN

There were 194 patients with basal cell carcinomas 117 were treated by irradiation stronger than previously given the lesion was controlled in sixty-six or 56 4 per cent. Fifty-six patients with basal cell carcinomas were treated with wide surgical excision and skin grafts, as indicated the lesion was controlled in forty-six, or 82 per cent Of the 194 patients with basal cell carcinomas that had had previous treatment, the lesions were controlled by irradiation or multiple surgical procedures in 160, or 82 per

cent Twenty-eight patients had a continuation of the disease after the multiple procedures had been used

There were twenty-eight patients with squamous cell carcinoma in the secondary group having adenocystic basal cell epitheliomas that were followed two were treated with irradiation with non recurrence in one Thirteen patients were treated with wide surgical excision either with electrosurgery or

TABLE 9

302 SECONDARY CASES THAT HAD PREVIOUS THERAPY

	BASAL CELL	SQUAMOUS CELL	ADENOCYSTIC	TOTAL
Total cases admitted	232	48	22	302
Indeterminate group—disappeared during therapy results of therapy unknown eighteen died of other causes	38	20	6	64
Total number studied	194	28	16	238

TABLE 10

RESULTS OF IRRADIATION THERAPY OF 238 SECONDARY CASES THAT HAD PREVIOUS THERAPY

	BASAL CELL	SQUAMOUS CELL	ADENOCYSTIC	TOTAL
Total number studied	194	28	16	238
Treated by irradiation therapy	117	4	2	123
Control of lesion by irradiation	66—56 4%	0	1—50%	67—53%

TABLE 11

RESULTS OF SURGERY OF 161 SECONDARY CASES THAT HAD PREVIOUS THERAPY

	BASAL CELL	SQUAMOUS CELL	ADENOCYSTIC	TOTAL
A. Electrosurgical excision skin grafts when advisable	64	18	8	90
Control of lesion by electrosurgical measures	48—74 4%	13— 2%	6—75%	67— 4%
B Wide surgical excision skin grafts when advisable	56	8		71
Control of lesion by surgical measures	46—82%	5 —62%	6—85%	57 —80%

TABLE 12

RESULTS OF 238 SECONDARY CASES THAT HAD PREVIOUS THERAPY

	BASAL CELL	SQUAMOUS CELL	ADENOCYSTIC	TOTAL
Total number studied	194	28	16	238
Control of lesions by irradiation or multiple surgical procedures	160—82%	16 —57%	13 —81%	189 79 4%
Patients having a continuation of the disease after multiple procedures	28	1	2	31 13 1
Deaths from recurrences or from operative procedures	6	11	1	18 5%

group that were followed four were treated with irradiation none of which were adequately controlled Electrosurgical excision or wide surgical excision was used in twenty-eight patients with squamous cell carcinoma the disease being satisfactorily controlled in sixteen or 57 per cent

There were sixteen patients in the secondary scalpel excision with twelve favorably controlled

There was a total of eighteen deaths resulting from metastases or following operative procedures a mortality of 7 5 per cent in this latter group of patients that had had previous treatment

A study of the tables given above will dis-

close an overlap of cases in most groups, caused by cases recurrent following one type of therapy being treated later by another modality Many patients in this secondary group will be listed under *irradiation therapy* and electrosurgery or surgery

MALIGNANT MELANOMA

Malignant melanoma is used to designate the malignant form of melanotic tumor as be divided into two general classifications, that is, cells that are ovoid in character and those that are spindle-shaped The ovoid cell form is more rapid in its growth metastasizes early, and is definitely more difficult to eradicate The spindle cell form is more likely to remain local is slow in producing metastases, and if metastases are formed they tend to remain localized for longer periods of time (Fig 147 A B)



Fig 147

A. Elevated darkly pigmented melanoma present since early childhood. Recently enlarged and became very much darker

B Photomicrograph shows masses of spindle cells with dark-staining nuclei few containing melanin pigment.

differentiated from pigmented mole or nevus. The latter was discussed in Chapter III on benign and premalignant lesions of the skin Much confusion has developed among pathologists and clinicians as to the etiology of this interesting group of tumors. We can be rather certain that the nevus or nevoid cell that produces the tumor commonly known as *melanoma* has never approached the normal cell In other words they are born outlaws of the most vicious type and remain so during their entire period of existence. (Hertzler) There is more evidence accumulating to substantiate the fact that they are of neurogenic, rather than epithelial or connective tissue origin Clinical observation has, however permitted them to

Etiology and Incidence

That malignant melanomas develop from a previously benign pigmented nevus in 84 per cent of the cases was shown by Affleck of the surgical pathological laboratories of the Johns Hopkins Hospital Affleck also found that 25 per cent of the entire group involve the scalp, face, neck, and oral mucous membranes. Pack found 23 per cent of melanomas occurred in the head and neck These observations are in accord with our own studies. Malignant melanomas are infrequently encountered in the Negro

Pack has reported an interesting series of melanomas in children which he terms the *pre*

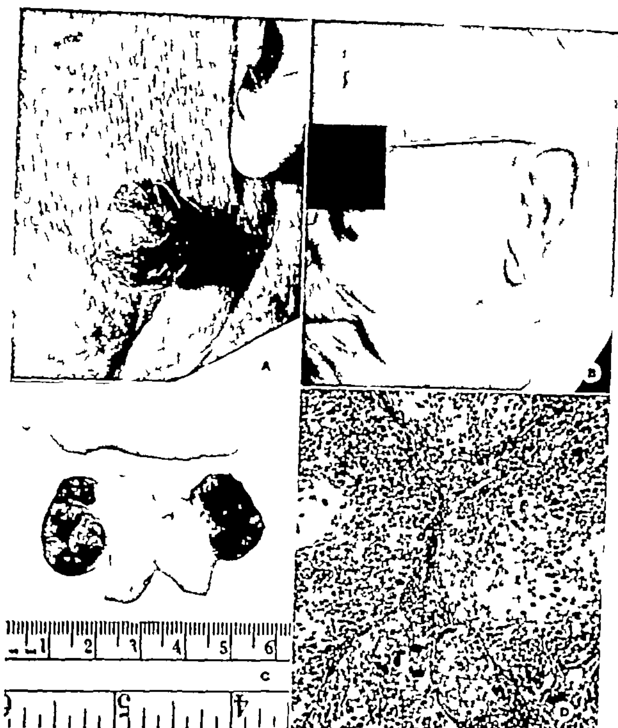


Fig 148 Mole present on left cheek for many years. During the past 2 years increased in size

A Rim of hyperemia developed around it The surface bleeds occasionally with oozing of ink like substance Dark black areas have developed in tumor This patient was treated many years ago—now we would dissect the neck in continuity with the tumor

B Surgical excision with no local recurrence.

C Surgical specimen shows the almost black melanotic tumor mass.

D Photomicrograph showing masses of cells varying in size and chromaticity with deep-staining nuclei Some are round and some are spindle shaped Melanin pigment is distributed throughout

pubital age group The prognosis in this group is much better than that in the more adult group He states that the microscopical appearance of the prepubital group is in no way different from the adult group and it is difficult for pathologists to distinguish between them In Pack s small group of fifteen cases none metastasized All of the patients survived indefi

nitely following thorough surgical excision of the local growth with a wide margin of skin around it It is his feeling that this tumor has a definite etiological relationship to the hormonal factors originating in the adrenal cortex gonads and pituitary gland Consequently all solitary, deeply pigmented melanomas found in children should be excised with a good margin of skin around the tumor before the patient reaches the age of puberty

Clinical Behavior

In reviewing the histories of malignant melanomas, it was noted that about 90 per cent of the patients had a solitary pigmented nevus or mole An early sign of malignant change is an enlargement of the primary mole and ulceration that never completely heals and tends to bleed at frequent intervals. Other moles show an alteration in color (Fig 148 A D) (darkening) with itching and pain in others there may be little change in the primary lesion but enlargement of the lymph nodes in the drainage area In still another group the first evidence of increased activity is the formation of numerous secondary growths around the primary tumor with or without enlargement of the draining lymph nodes. This latter form quickly develops widespread metastases and is most difficult to manage (Fig 149) Melanomas that are located in areas repeatedly traumatized, i.e. the scalp by combing the hair on the temple irritated by the hat band, on the neck, irritated by the collar button may be precipitated into activity by such chronic irritations (Fig 150 A–D) On the other hand the irritation may only serve to call to the patient's attention that activity had already developed Often the first symptom is marked involvement of a group of lymph nodes, and only by careful examination can the small nonactive-appearing melanoma be found It is this group that gives the most hopeless prognosis. It was discussed at some length in Chapter III and suggested that all solitary pigmented nevi in areas subject to repeated trauma be widely excised (Fig 151 A C)

Treatment

The treatment of malignant melanoma is surgical Our observations have confirmed those of others (Pack and his co workers) that melanoma is resistant to irradiation true of the primary tumor and local and distant metastases. Previous to 1935 in their clinic irradiation in its various forms was used as the primary mode of treatment Following 1935 surgical measures were established as the primary therapeutic agent. A comparison of the two methods shows that for a localized melanoma surgery yielded a 38 4 per cent salvage at three years, as against 1 6 per cent for irradiation, and 17 7 per cent, as against none for five-year survival (Pack et al) The same proportionate increase in the salvage is revealed in the treatment of patients with metastases to the regional lymph nodes.

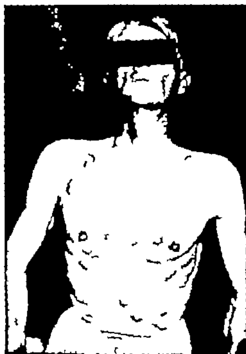


Fig 149 Malignant melanoma rapid widespread metastases from small insignificant-appearing lesion anterior chest wall.

The problem of handling malignant melanomas divides itself into three considerations. Each will be discussed separately on the basis that the most important surgical principle in the handling of melanoma is wide and deep surgical excision of the primary lesion and lymph nodes draining the area en bloc

Fig 150

A Pigmented mole hairline right temple several years duration Irritated by combing hair Developed secondary growths around primary lesion Local surgical excision extending through temporal fascia. Treated several years ago. If treated at this time Pack technic would be used.

B Result after excision and skin graft

C. Photomicrograph (low power) masses of undifferentiated cells with dark staining nuclei Melanin pigment present.

D Photomicrograph (high power) ovoid cells with dark-staining nuclei some containing melanin pigment This type is very difficult to control.

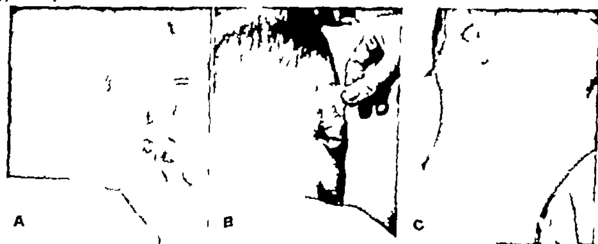


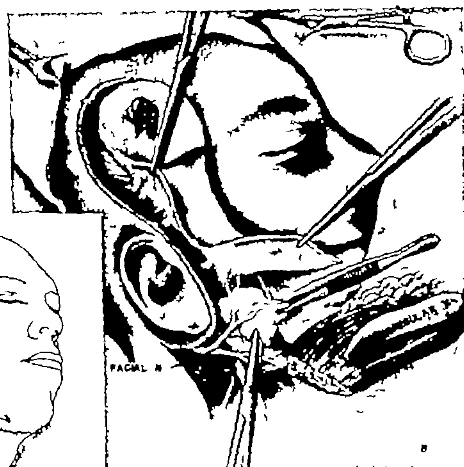
Fig 151

(A. Malignant melanoma posterior surface of ear

B Thorough removal with electrosurgery

C. Neck dissection positive nodes just below ear Patient died of cerebral metastasis one year later without local or nodal recurrence Patient was treated in 1932 If treated at this time would have had excision of ear and surrounding skin subcutaneous tissue fascia and radical neck *en bloc* according to the technic of Pack





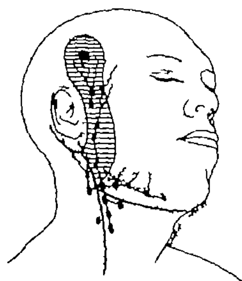


Fig. 152

A. Bluish-black mole hairline right temple irritated by brushing hair Present since childhood Incompletely removed twice elsewhere with electrodesiccation Recurred immediately following each. Numerous skin implants around primary lesion.

B Pack's technic for radical excision of primary growth surrounding skin subcutaneous tissue and lymph drainage area in continuity (Courtesy Pack, Perzik and Scharnagel. California Medicine.)

Any solitary melanoma showing growth tendency should be widely excised down through the subcutaneous tissue to the muscles or to include at least one or two centimeters of soft tissue beneath and three centimeters of skin around the primary lesion often necessitating a split thickness or full thickness skin graft. It is only by such extensive treatment that good results are obtained.



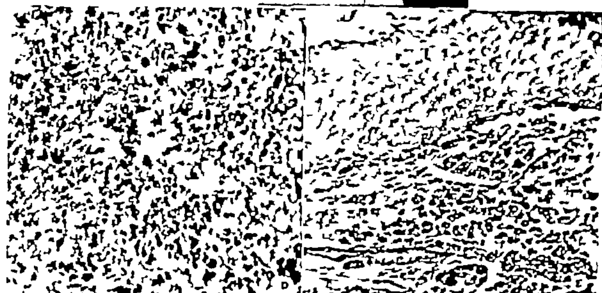


Fig. 152 C E

C The same patient 31 days after operation.

D Photomicrograph (×120) Infiltration with strands and nests of cell varying in size with dark staining nuclei containing melanin.

E. Photomicrograph (×250) both round and spindle cells present with dark staining nuclei Numerous cells containing melanin pigment. (See color plate II)

Clinical evidence of malignancy as darkening rapid growth a rim of erythema and a history of bleeding at intervals requires the

same surgical principle of wide excision so universally practiced in the management of other malignancies, for example, radical breast operation including axillary nodes in continuity, the Miles procedure in carcinoma of the rectum and hemithyroidectomy in carcinoma of the thyroid gland with radical neck dissection on the side of involvement When it is appreciated that malignant melanoma is a far more difficult neoplasm to control than these others because of its tendency to more rapid and widespread metastases, it is understood why deep surgical excision is imperative. Without strict adherence to this surgical principle, frequent local recurrences appear in the surrounding skin and quickly there are metastases to the local and/or distant lymph nodes. In addition to a skin margin of 3 cm, the surrounding skin must be undermined for 2–3 cm on all sides and left very thin to prevent retrograde permeation of the tumor cells through the skin lymphatics, and also permitting the removal of a wide border of subcutaneous fat and fascia down to the muscles with local growth *en masse* The wound is grafted

The problem of removal of the lymph node bearing area in continuity with the local growth when no nodes are palpable is ever present The answer depends on several factors, namely, the location of the tumor, the age and condition of the patient along with a histological examination of the tumor or a history of rapid growth If there is a history of rapid growth and if histologically the cells are ovoid in character the tumor should be excised widely as described and in continuity with radical dissection of the lymph node-bearing area, as developed by Pack (Fig 152 A–E)

When there are numerous small implants around the parent tumor or involvement of the nodes in the drainage area, or both the safest principle is wide excision of the tumor surrounding skin subcutaneous tissue fascia and lymph node bearing area *en masse* Since melanomas are vicious neoplasms and metastasize early and extensively we feel that all such tumors which microscopically or clinically are suspicious of malignancy should be treated radically This applies to the more slowly growing spindle cell type, as well as the rapidly spreading ovoid cell variety This principle pertains to all cases with or without palpable firm lymph nodes

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Chapter V
BENIGN TUMORS AND PREMALIGNANT LESIONS OF THE LIPS

As with benign tumors and premalignant lesions elsewhere in the body early diagnosis and treatment are important in curing the patient and preventing the development of malignant disease. Any definite tumor or other lesion that produces ulceration or induration should be considered potentially malignant until proven otherwise.

Biopsy

The removal of tissue from the lips for microscopic examination is such an easy procedure under local anesthesia that it should be resorted to much more frequently than in the past The local anesthesia is injected at a safe margin from any area to be biopsied Very fissure or wart or lump or indurated area over 3 or 4 mm in diameter requires biopsy by a V-shaped excision (Fig 153 A and B), under local anesthesia without hospitalization Suffi

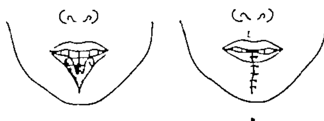


Fig. 153

A. Small V-excision of suspicious lesion of lower lip taken for biopsy

B V incision closed in layers using interrupted 0 chromic catgut in the submucosa and muscle. Interrupted black silk through the skin

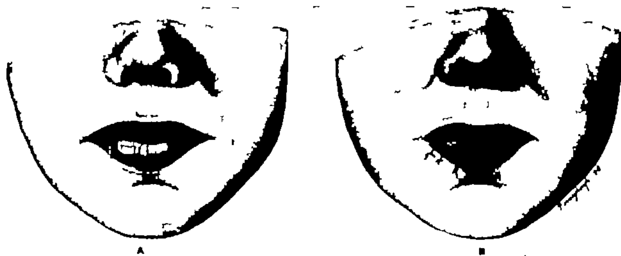


Fig 154 Nelaton s method of removal of small growths on the lip

A. The mucous membrane is incised on each side of the growth at a safe margin These two incisions are connected by a third running along the muco-cutaneous border A fourth incision not shown in the illustration is on the mucous membrane side of the lip.

B Wound closed by undermining mucous membrane on each side and bringing edges together with black silk sutures. The muco-cutaneous border is likewise re-established by pulling the mucous membrane forward to the skin margin and suturing with interrupted black silk.

superficial lesions are biopsied with a rongeur like forceps, taking in a depth of tissue sufficient to be typical of the disease at hand Any cient tissue is obtained to give an accurate opinion of the relationship of the disease process to the normal structures. Figure 154

A and B illustrates an alternate method of biopsy and removal of small growths described by Nelaton and Ombredanne. (1907)

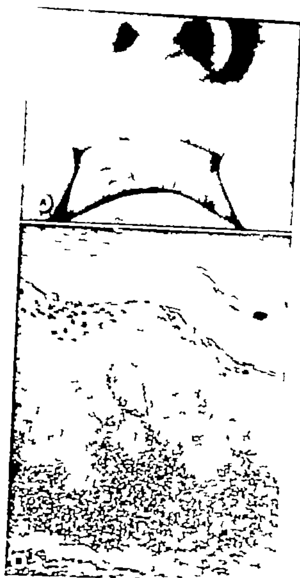


Fig 155

A Elderly man with hyperkeratosis on the vermilion border of the lip and leukoplakia on the mucous membrane side Note how the two processes blend together and really are indistinguishable

B Photomicrograph of leukoplakia (see Fig 168 B for area of early carcinoma)

HYPERKERATOSES AND LEUKOPLAKIA

Hyperkeratosis of the lips should be considered as a premalignant lesion occurring most commonly in people who are exposed to weather as farmers policemen watermen etc., and is often associated with hyperkeratosis of other areas of the skin of the face neck, and hands. The lips are scaly and rough (Fig 155 A and B) and bleed slightly when the scales are removed. As the process continues the skin of the lips becomes thicker and indurated (Fig 156) During the examination the lips should be palpated between the fingers to determine any thickened areas suggestive of malignant change In our series of 259 cancers of the lips (Chapt VI) seventeen patients had



Fig 156. Leukoplakia and hyperkeratosis of the lower lip. Note the piling up of leukoplakia on the mucous membrane side of the lip almost to papillary formation.

leukoplakia and twenty-five had hyperkeratosis a total of 42 or 16.2 per cent

HISTOLOGY

Histologically hyperkeratosis and leukoplakia are indistinguishable A further discussion of leukoplakia will be presented in Chapter VII Benign Tumors and Premalignant Lesions of the Oral Mucosa. It is not uncommon for leukoplakia to occur on the inner side of the lip simultaneously with hyperkeratosis on the vermilion border In such a case a microscopic section through the entire lip will show the processes histologically the same whether leukoplakia or hyperkeratosis. One can distinguish between the two only by observing the structure of the normal tissues around it on the mucous membrane side there will be mucous glands, but no hair follicles.

Under the microscope the squamous cell layer is seen to be hypertrophied there is thickening and piling up of the upper layers with scaling cracking and gradual peeling off There may

or may not be lymphocytic infiltration below the epidermis. Rete pegs are elongated, but the basal cell layer is not broken

CLINICAL BEHAVIOR

Clinically when this hyperplasia of the squamous epithelium occurs on the mucous membrane bathed with saliva, the tissues are soft and there is less likelihood of scaling off The patch is white and has an almost dry appearance in spite of the fact that it is covered with saliva The mosaic pattern (Fig 155 A) is due to the thickened hyperplastic squamous epithelium cracking and forming irregularly shaped designs over the surface On the lip side, where the skin is dry, the resultant cracks permit the thickened epithelium to curl up and produce a scaly appearance.

TREATMENT

In the early stages of hyperkeratosis, the application of mild ointments, such as vaseline or light oils, to the lips often will soften and heal the lesion without further difficulty If the scales are rather thick and show a tendency to produce excoriations on the lips, then electrodesiccation is indicated Under local injection anesthesia of 1 or 2 per cent procaine, the needle electrodesiccator is passed over, or gently touched to the surface until the entire area is dehydrated. This dehydrated tissue is curetted away and the base re-treated Two per cent gentian violet solution in alcohol (50 per cent) and acetone (10 per cent) is applied to keep down infection The area heals in two or three weeks. During the healing period the patient is instructed to wash the lip with boric acid solution or 70 per cent alcohol two or three times daily to keep down the thick scabs resulting from saliva and serum accumulating and drying

Three or four threshold erythema doses of irradiation given either with radium or x ray often suffice to eradicate hyperkeratosis and leukoplakia

It is not uncommon to find that the entire lower or less commonly the upper lip is involved by the hyperkeratotic process. For these more advanced cases an operation has been described which we have found quite advantageous (Fig 157, A B and C) Under local injection anesthesia the entire vermilion border of the lip is excised with a safe margin from one angle of the mouth to the other The mucous membrane on the inside of the lip is then undermined and loosened by blunt dissection and brought forward and outward and sutured with interrupted black silk to the skin margin This reconstructs the mucous membrane of the lip replacing the hyperkeratotic skin with mucous membrane. It would seem

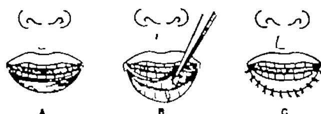


Fig 157

A. Operation for removal of entire vermilion border of the lip for hyperkeratosis. Vermilion border of lower lip has been denuded

B Mucous membrane on inner side of lower lip has been mobilized by undermining so that it may be advanced forward to meet the skin margin.

C Mucous membrane sutured to skin margin with interrupted black silk sutures.

that such a lip might be moist because of the change of character of the vermilion border from squamous epithelium to mucous membrane. The few cases that we have so treated have not complained of moist lips and have gotten along very well Should there be any thickened areas in the lip a wider margin and a deeper excision is carried out.

FISSURES

Fissures of the lips are quite common (Fig 158), and like hyperkeratoses, occur frequently in people exposed to the elements. Fissures may appear anywhere on the lips but are often found in the midline or at the commissures, they are seldom seen on the upper lip and may or may not be associated with hyperkeratosis. The great danger of fissures is that infection enters, and chronic inflammatory reaction is set up with gradual change into malignancy

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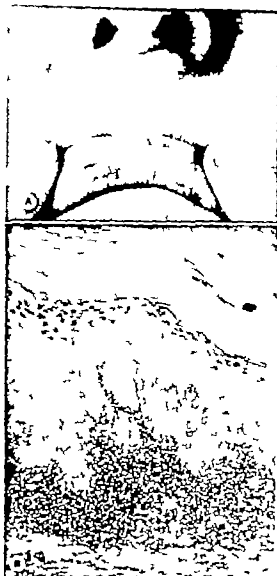


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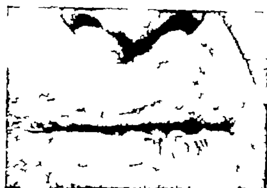


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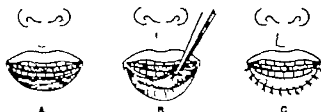


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We feel that all fissures should be considered as potentially malignant until *proven otherwise.* Particularly is this true when there is considerable induration beneath the fissure. Superficial fissures without any evident induration can be destroyed with electrodesiccation under local anesthesia. The needle desiccator is inserted at a safe distance and the lesion surrounded by a line of desiccation outlining the area to be destroyed The fissure itself is then attacked by inserting the needle from place to place, holding it sufficiently long each time to cause blanching The dehydrated tissue is curetted away and the base re-treated



Fig 158. Chronic fissure of lower lip

Should there be any evident induration beneath or around the fissure an adequate V-shaped excision (Fig 153) should be done under local anesthesia. It must be stressed again that the local anesthesia should be injected at a safe distance from the lesion to prevent any possible dissemination of malignant cells if present The V-shaped defect is closed in layers Interrupted O chromic catgut sutures in the submucosa close the mucous membrane A second layer of like sutures approximates the muscles and the skin is closed with interrupted black silk A light waterproof dressing made by saturating a few layers of gauze with dermatome cement is applied and allowed to remain for about a week When the dressing is taken off the stitches are removed and the wound is found to be healed

Removing fissures through a V incision furnishes adequate material for microscopic examination. If early cancer is found and if a wide enough excision has been carried out probably no further treatment is indicated (see Chapter VI)

CHEILOSIS—AVITAMINOSIS—PERLECHE

Vitamin deficiencies cause certain changes in the lips which bear mention here in order to differentiate from early cancer According to Martin and Koop, "neither perleche nor cheilosis are precancerous lesions in themselves, but they usually indicate the presence of other degenerative changes within the mouth on the tongue or cheeks, which at these sites are precancerous. Perleche is a scaly crusted, fissured erythema at the labial commissures which may extend for a short distance on the vermilion border when the term *cheilosis* is applied. The diagnosis is not always easy in the early cases and may only be made after administration of large doses of vitamin B complex. In the more advanced, where there are associated symptoms of vitamin B deficiency elsewhere in the body such as dermatosis, fragility and dystrophy of the fingernails, malnutrition and asthenia, the differential diagnosis is much easier If there is any doubt as to the presence of malignancy a biopsy should be made There has been much discussion in the literature as to which of the vitamin B complex is deficient to cause these symptoms. Martin and Koop feel that large doses of the entire vitamin B complex should be given and report excellent results from their therapy They prefer natural concentrates, such as yeast or liver and have given as high as 45 gm of granular yeast daily

VERRUCA (WART)

Solitary warts are occasionally seen on the lips, both upper and lower but more commonly on the lower lip In our experience these warts have not been associated with the common virus wart seen elsewhere on the body Their clinical importance is, first in differential diagnosis from early carcinoma and, secondly they should be immediately removed to prevent malignant change These warts are quite

typical in appearance and look like an ordinary verruca seen elsewhere They are usually small, being 3 or 4 mm in diameter (Fig 159), and about the same height Others are larger and more hornified in appearance (Fig 160) and are apt to undergo malignant change. The wart should be carefully palpated between the thumb and finger to elicit any beginning

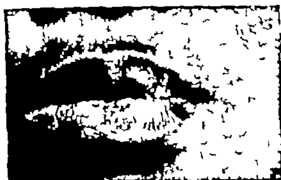


Fig 159 Benign wart of lower lip readily removed with electrodesiccation under local anesthesia. Any induration of the base requires removal with biopsy forceps before electrodesiccation



Fig. 160. Benign wart of lower lip This type is treated by removal with biopsy forceps for microscopical examination and thorough destruction of the base with electrosurgery

induration in the tissues beneath If induration is present the wart should be excised through a V-shaped incision and with a good margin. The tissue is then subject to histological study

Most of the small warts yield to electrodesiccation under local anesthesia The wart is removed with biopsy forceps for microscopic examination and then the base is thoroughly dehydrated by a monoterminal desiccating current carried on a needle electrode. The destroyed tissue is curetted away and the base thoroughly re treated Healing takes place in two or three weeks

EPITHELIAL PAPILLOMAS

Squamous cell papillomas are not uncommon on the lips These tumors often attain considerable size, appearing like large horns The hornified portion consists of desquamated keratinized squamous epithelium and dried saliva, and when removed leaves an actively growing papillomatous base (Fig 161 A, B and C) They should be removed with a wide margin using a V-shaped incision because of their likelihood of undergoing malignant change. Histologically there is marked hyperplasia of the squamous epithelium which is thrown into papillomatous projections. The rete pegs are greatly elongated many epithelial pearls are present The stroma shows marked round cell infiltration, evidence of infection and inflammatory reaction Figure 162 is that of a large epithelial papilloma, developing in the skin at the commissure of the lips Leukoplakia and hyperkeratoses were scattered over the mucous membrane and vermilion border This man had definite squamous cancer in the growth These cases illustrate the need of adequate microscopic study to determine the presence or absence of cancer

LOCAL HYPERTROPHY OF THE MUCOSA

Hypertrophy of the mucous membrane of the lips occurs as the result of trauma from biting the lip a malfitting denture or an irregular tooth These pseudo tumors are soft more or less rounded and covered with normal mucous membrane. They are distinguished from mucous cysts by being firmer and of normal mucous membrane color Mucous cysts usually have a bluish tinge due to the contained mucous. These areas of hypertrophied mucosa vary from a few millimeters to a centimeter or a centimeter and a half in diameter They are firm to hard depending



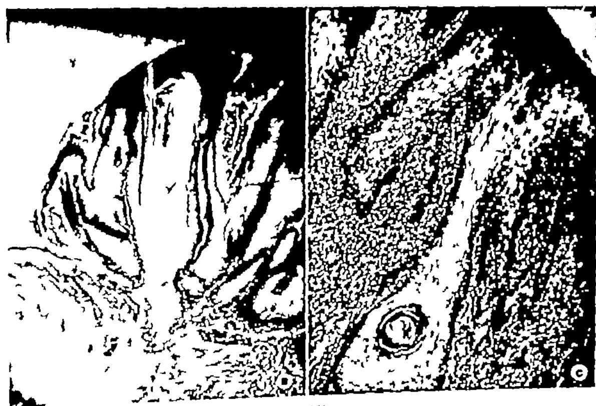


Fig 161

A. Large hornified papilloma on lower lip best removed by V-excision under local anesthesia furnishing adequate tissue for microscopic examination. The hornified area came off as dried mass during the operation leaving the large papilloma shown in "B"

B Low power photomicrograph. There is no infiltration at the base and no evidence of invasion

C. High power photomicrograph showing hypertrophy of rete pegs, one of which contains an epithelial pearl. There is marked inflammatory reaction in the submucosa.

upon the amount of fibrous tissue beneath the mucous membrane (Fig 163)



Fig 162 Patient with diffuse epithelial hyperplasia appearing as leukoplakia on the mucous mmebrane, hyperkeratosis on the vermilion border and epithelial papilloma with carcinomatous changes in the skin of the commissure of the right side of the mouth.



Fig. 163. Localized hypertrophy of the mucous membrane This is a benign lesion and probably due to chronic trauma The mucous membrane over it is normal. The bulk of the tumor is made up of connective tissue and fibroblasts carrying blood vessels.

Treatment is surgical or electrosurgical removal, and is readily accomplished in the office under local anesthesia. The tumor is picked up in a clamp and excised around the edge with a strong electrosurgical cutting current The wound is then sterilized with electrodesiccation healing taking place by granulation in three or four weeks. Histological examination reveals a normal mucous membrane covering a mass of fibrous and connective tissue containing blood vessels In one patient we noted an ulcer in the mucous membrane, evidence of repeated trauma. For this reason all of these lesions should be removed to prevent malignant change in the traumatized mucosa. These lesions are similar to mucous membrane hypertrophy on the gingiva caused by mal fitting dentures

MUCOCELE

Mucous cysts occur on the mucous membrane or vermilion border of the lips as rounded soft tumors with a bluish tinge due to the contained clear mucous. These cysts are due to obstruction of the mucous glands the gland becomes distended with mucous and, on microscopic examination, shows that the epithelium has been flattened by pressure to a squamous cell type, losing its original characteristics. Unless traumatized, the cyst is covered by normal epithelium (Fig 164 A, B)

The chief interest in these tumors is their differential diagnosis from other more serious lesions. They also are annoying to the patient because of their size, sometimes reaching a centimeter or more in diameter and are frequently injured by the teeth, causing bleeding and permitting infection to enter

Their treatment is surgical. Under local anesthesia the overlying mucous membrane is incised the sac dissected out and the wound sutured with interrupted 00 plain catgut The smaller ones are destroyed with electrodesiccation under local anesthesia as an office procedure. Healing is then by granulation

ABERRANT SALIVARY TISSUE TUMORS

Aberrant salivary gland tissue is occasionally encountered in the lips as rounded, firm, discrete, painless nodules. One of our cases was that of a colored girl who came into the acci

dent room with a *laceration* of the lower lip This was sutured and healed *per primum* In about a month or six weeks she returned with a lump deep in the lip, which on excision was found to be a tumor of aberrant salivary gland tissue Another case had a large nodular tumor involving almost half of the upper lip

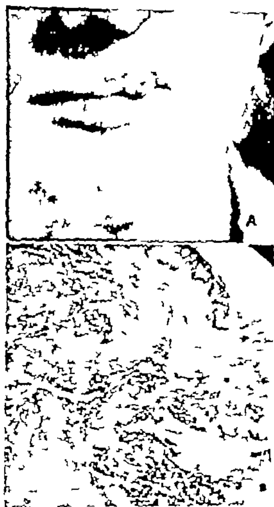


Fig 164 Mucocele of upper lip

A Lesion is round smooth and soft and has a bluish tinge

B Photomicrograph of mucocele.

and lay *just beneath* the skin A third case (Fig 165) appeared on the left side of the lower lip as a slightly elevated dome-shaped swelling The skin over it was attached and showed radially-placed telangiectases. It had been removed two or three years previously but recurred. A large V-*shaped incision* removed the tumor and the lip was closed Microscopic examination showed a combination of hemangiomatous elements and salivary tissue tumor A more detailed discussion of salivary tissue tumors is given in Chapter XI

HEMANGIOMAS

In Chapter III on *benign skin tumors* a discussion of hemangiomas is given at length. In this chapter hemangiomas of the lips which present certain definite problems will be outlined.



Fig 165 Aberrant salivary tissue tumor left side of lower lip. Histologically the tissue showed a combination of hemangiomatous elements, along with mixed salivary tissue tumor

Hemangiomas of the lips in infants are quite common Like hemangiomas elsewhere in the skin they may be present at birth or appear shortly thereafter usually within the first two or three weeks of life Their general appearance is similar to hemangiomas in the skin except that their surface is more smooth and glistening due to the thin overlying vermilion border and the mucous membrane. They blanch on pressure and are compressible and are found on any part of the upper or lower lip Ward and Covington found that in *127 hemangiomas, 11.8 per cent occurred on the lips. Most of these cases were* in infants and young children

Occasionally hemangiomas in infants do not completely disappear under irradiation there remaining a small amount of the tumor on the

mucous membrane side which is readily eradicated under local anesthesia by electrodesiccation Slight sloughing occurs and healing takes place by cicatrization, the scar being on the inner side of the lip is hardly noticeable and not disfiguring

The importance of hemangiomas of the lips is three-fold cosmetic, in infants functional or interference with feeding and the possibility of ulceration, hemorrhage, and infection It is for these three reasons that treatment of hemangiomas of the lips in infants is urged more emphatically than the treatment of most other hemangiomas of the skin in areas not subject to trauma and irritation

Hemangiomas usually occur along the vermilion border, but may extend onto the mucous membrane, and occasionally onto the alveolar arches and onto the skin Surgical procedure may be associated with considerable disfigurement. Hence radium therapy is preferable. The details of radiation therapy are presented in Chapter III Radium treatment must be given carefully in small doses to obviate any injury to the tooth buds. In our rather extensive experience we know of no case where the tooth buds have been permanently injured

Hemangiomas of the lips in adults are not common When they do occur they usually are congenital and have remained throughout life or are secondary to trauma. Hemangiomas in adults are as a rule, not sensitive to radiation Their treatment when located on the lips, is entirely surgical The surgical procedure employed in a given case depends upon the extent, size, and deformity that may result Small ones can be removed by a V-shaped excision Larger ones require more radical excision with appropriate plastic procedures, illustrated elsewhere in this chapter for other lip tumors (Fig 153 A and B)

GRANULOMAS

(*Traumatic and pyogenic*)

Acute trauma causing a break in the vermilion border of the lip often gives rise to rapidly growing vascular easily bleeding tumors, which microscopically are difficult to differentiate from true hemangiomas (Fig 166 A and B) Some pathologists call these tumors vascular granulomas' others infected hemangiomas.' The histological picture



Fig 166. Pyogenic granuloma

A Lesion followed trauma of lower lip six weeks previously

B Photomicrograph showing acute granulation tissue beneath thin layer of epithelial cells very easily broken giving rise to hemorrhage.

is of a very vascular lesion with marked lymphocytic and leukocytic infiltration They are particularly prone to develop in children One of our patients, a young farmer boy about eight years of age struck his lower lip with the

handle of a shovel three or four weeks prior to admission The lesion was about 6 or 8 mm. in diameter and almost a centimeter high It was soft and bled freely when traumatized. Prompt healing occurred after electrosurgical removal under local anesthesia. Histological examination showed the typical picture of an infected vascular tumor This type of infected hemangioma or granuloma occurs both on the lips of children and adults. They also are seen on the tongue and on the skin of the face

MILIA

Milia are tiny rounded, pearly hard nodules in the skin, very seldom larger than a millimeter in diameter usually occurring near the eyes, at the angles of the mouth or along the lips, particularly the lower at the junction of the vermilion border with the skin. They represent a tiny superficial type of sebaceous cyst. Attention is called to them here as a matter of differential diagnosis from certain lip tumors. Occasionally a patient comes for advice, particularly nowadays when the general public is so cancer-conscious The typical character of the lesion is enough to rule out cancer

Treatment consists of incision of the very thin layer of skin covering them and evacuation of the hard, pearly nodule with a small curette and with or without injection anesthesia.

PREGNANCY TUMORS

A type of hemangioma occasionally appears in women during pregnancy and disappears after delivery We have seen these pregnancy tumors occur on the jaw chest, and lips. One case had an extensive birthmark involving the lip, buccal mucous membrane, and skin of the cheek. During each of several pregnancies, this hemangioma took on rapid growth including soft nodular developments and receded after pregnancy The single lesions are rounded red or reddish-blue, typical looking hemangiomas, approximately 1 cm. or slightly more in diameter They bleed on trauma and recur after removal until the pregnancy has terminated then they disappear permanently until another pregnancy They are of no great practical significance unless they bleed freely in which case they should be removed either with electrosurgery or by surgical excision.

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Chapter VI

CANCER OF THE LIPS

Cancer of the lips is the most prevalent cancer of the upper respiratory, and alimentary tracts (Martin) Due to its location and characteristic appearance, diagnosis should be made early and, if prompt, efficient therapy is instituted, a high percentage of cures will result The ideal situation of early diagnosis and proper therapy is all too infrequently utilized by the patient and the attending physician because of procrastination ignorance, and self treatment. The patient frequently does not consult the physician until late and if a charlatan or regular physician does not take the time and effort to make a correct dalgnosis, or lacks the experience to do so the result is incomplete treatment and much disfigurement with poor cosmetic results and a substantial mortality

INCIDENCE

In a review of 259 cases of carcinoma of the lips that were treated in the Tumor Clinics of the Johns Hopkins Hospital and the University of Maryland Hospital, and in private practice, from January 1 1926 to January 1 1945, it was found that the majority occur in males, there being 251 males and eight females Table 13 evidences the fact that this disease is more frequent in older patients although there were three cases under thirty years of age. A review of the histories of these three cases shows the unfortunate fact that they were treated by their family physicians until metastases developed as it was not appreciated that malignancy can develop in the lips at an early age

Cancer of the lips, as well as cancer of the skin is more frequent in the white than in the Negro race. This is probably due to the protection afforded by the increased amount of pigment in the skin of the colored Malignant melanoma, also is infrequently encountered in the colored race. There were only seventeen Negro patients in this series, a marked contrast to intraoral cancer which is often seen in the Negro Table 13 shows that a substantial percentage of the patients were over seventy years of age. Many clinicians erroneously think that people of sixty or seventy years of age do not tolerate the treatment necessary for advanced lesions This has not been our experience, for the majority of aged patients tolerate satisfactorily surgical measures or irradiation sufficient to eradicate their disease Considerable thought is given to nutrition and prophylaxis against shock when operative procedures are necessary in the older age group of patients, especially if they have advanced lesions.

TABLE 13

Ages of 259 Cases of Carcinoma of the Lip

20-30	3
30-40	12
40-50	55
50-60	55
60-70	73
70-80	51
80 plus	10

ETIOLOGY

Cancer of the lips as cancer of the skin of the hands and face, is more common in individuals with a thin dry skin without much pigment especially when exposed to the elements, wind and intense sunlight Formerly the use of tobacco was thought an important etiological factor, however we do not consider it as such except the occasional patient that smokes a pipe and keeps the pipe stem in one position constantly Eighty-seven per cent of the patients in this series smoked an approximate percentage of smokers encoun

tered in the male population Recurrent trauma or chronic irritation from varying causes (Fig 167 A and B) may act as a precipitating factor Some unique forms of trauma



Fig 167 Patient, white male aged 48 years, states while eating corn with a fork he stuck his lip lesion did not heal.

A. Elevated lesion 1.5 x 1 cm on the lateral third of lower lip Palpable nodes in submental area, left side Biopsy squamous cell carcinoma, Grade II.

B Wedge-shaped excision of tumor with suprahyoid neck dissection on left side Lymph nodes positive. No recurrence of this lesion Returned 2 years later with carcinoma, right side of lip

are interesting to relate, as the case of a carpenter who held his nails in his mouth that of a butcher who held his knife between his teeth when it was not in use, and a farmer who was stung on the lip by a bee and kept a "chaw" of tobacco over the bee-bite to take the swelling out also a WPA worker who stated he stuck his lip everytime he ate peas with a knife and last but not least a farmer who bit his lower lip with a long buck tooth when he got mad with his wife which he did several times a day

In Chapter X on benign lesions of the lips, it was pointed out that keratoses, leukoplakia (Fig 155 A and B) warts, chronic fissures, and papillomas are frequently *precancerous* lesions (Fig 168, A and B) Especially is this true when they occur in the commissures. A precancerous lesion is defined as one which may during its course, develop into malignancy Such lesions as syphilis, adenomas, hemangiomas, tuberculosis, cysts, and granuloma pyogenicum have little tendency to become malignant. It is only by the eradication of the premalignant lesions that cancers of the lips may be prevented in a high percentage of cases. *Thirty-eight per cent of our series* (Fig 169 and 170) gave a history of having a precancerous lesion before definite malignancy developed

Syphilis has been incriminated in the past as a precursor of cancer of the lips and all too frequently patients with a lip lesion perhaps simulating a chancre, and a positive serological test *for syphilis are treated indefinitely for* syphilis until the malignant lesion has become extensive Five per cent of this group of patients had a positive serological test for syphilis, which is about the usual percentage of syphilitics in clinical patients (Martin) Unfortunately nine of these patients with syphilis and cancer of the lips were treated elsewhere for from six to twenty four months with the erroneous diagnosis due to the neglect of a biopsy Six of these developed extensive metastases. *It might be mentioned* that syphilitic chancres are more frequently encountered on the upper lip whereas, malignancy occurs more often on the lower lip The history is also of importance chancres have a history of only a few days or weeks' duration where cancer history is usually longer The syphilitic infection is always accompanied by adenopathy as seen in an



Fig 168

A Patient white male aged 52 years. Leukoplakia on mucosa and hyperkeratosis on vermilion border and skin present four years. Palpation revealed tiny area of induration which was removed by wedge shaped excision.

B Low power photomicrograph through entire thickness of lip Leukoplakia on right is typical hypertrophy of squamous cell epithelium with downgrowth of rete pegs. In right center is the earliest squamous carcinoma that we have encountered (See Fig 155 B for area of leukoplakia.)

acute infection The enlarged nodes do not have the hard, shot like feel of malignancy

Dental defects and trauma may act as precipitating factors. Twenty-six per cent of



Fig 169 Patient, white male aged 68 years. Leukoplakia on mucosa and papilloma in commissure, right side. Both had been present five years. Squamous cell carcinoma found on microscopic examination.

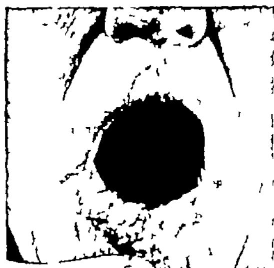


Fig. 170. White male aged 70 years. Epithelial wart on lip eight years, began to grow rapidly resulting in papillomatous type of growth measuring 2 cm in diameter Biopsy squamous cell carcinoma Grade I.

this group of cases gave a *history of either* single or repeated trauma to the lip at one time or another, resulting in a laceration or fissure that failed to heal Carcinoma of the cheeks *tongue* or the mucous membrane of the cheeks often follows chronic trauma by sharp or worn teeth Such trauma also precedes carcinoma of the lip to a lesser degree, probably because only a few teeth contact the lips. Patients of this age group are commonly edentulous and may or may not wear dentures which are seldom ill fitting enough to produce trauma sufficient to excite *the development of carcinoma* and in all probability serve only to call the patient's attention to the lesion present

ANATOMY AND HISTOPATHOLOGY

By definition cancer of the lip arises from the mucous membrane of the vermilion border All are squamous cell carcinomas and vary from the well differentiated Grade I to the highly anaplastic Grade IV When a basal cell lesion is present it must have developed in the skin and extended onto the vermilion border

Eighty-four per cent of the patients in this series that had no previous treatment other than innocuous salves before registering at the clinic had histological Grade I or II malignancy We have confirmed the observation of Figi that an acute inflammatory condition *superimposed on a malignant growth or the* tissues surrounding the growth increases its activity Also, therapeutic agents, as escharotics, incomplete removal with electrosurgery radium, or surgery and exposure to the elements, act as stimulating factors. These agents, when used inadequately fail to completely destroy the growth which increases in activity It is not uncommon for Grade I or II lesions to develop into the higher Grades III or IV with an increased likelihood of metastases. This is well exemplified in Table 16 which shows that seventy nine cases previously treated on the average had a higher histological grade than the average of the 180 cases that had no previous therapy before consulting the clinics. Escharotics and irradiation given *in inadequate doses* were shown by Figi to be the agents that seem to have a more stimulating effect on the tumor than any others.

The lower lip was involved in 239 cases, and

the upper lip in twenty Cancers occur in about the same percentage in the three areas of the lower lip, that is the central third and the two lateral thirds. The commissures are they metastasize earlier, and the lesion is more undifferentiated histologically As in other areas of the body two distinct carcinomas may be present on the lip at one time There



Fig 171

A. Fungating carcinoma, upper lip duration 3 months. Biopsy squamous cell carcinoma, Grade III.
B Lesion treated with x-ray (6000 r) Deformity of upper lip. Lip lesion remained well. Later leukoplakia appeared on upper alveolus on same side which developed carcinoma.
C. 18 months later metastases. Postauricular nodes demonstrating wide distribution of metastases from upper lip.

infrequently involved, being the seat of a malignancy only twenty two times in this group Most observers are of the opinion that lesions involving the commissures and upper lip (Fig. 171 A B and C) are difficult to control, as their development is more rapid

were six cases that had two distinct lesions, all occurring on the lower lip

Lymphatics of the Lips

It is very important for the oncologist to have definite knowledge of the lymphatic

system of the tissue that is being treated for malignancy The lymphatic system of the lips has been described well (Fig 172) by *Dorendorf Sassier, Rouviere and Most.* The lymphatics begin in a fine capillary net work in the vermilion border of the lips and *combine to form collecting trunks. The trunks* from the lower lip pass to the mental submental and submaxillary nodes, and some *into the mental foramen of the mandible* from the upper lip and the commissures the trunks pass to the preauricular, postauricular *infraparotid, submaxillary and submental*

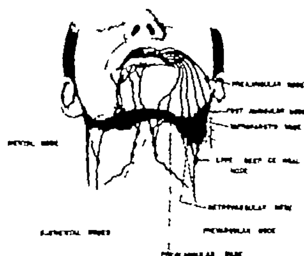


Fig. 172 Anatomy of the lymphatics of the lip Note the wide distribution of the lymphatics from the upper lip and the commissures also that the lymphatic trunks from the lower lip enter the mental foramen (Redrawn from Rouviere Edwards Publishing Company Ann Arbor Mich.)

nodes. There is free anastomosis of the lymphatics across the midline, both in the upper and lower lips, accounting for the frequent bilateral metastases, especially from growths that occur in the middle third of the lip

A fact habitually overlooked is that the collecting trunks from the lower lip especially the lateral third, enter the mental foramen and by this route involvement of the mandible takes place. It was formerly *thought* that invasion of the mandible was by direct con*tinuity of* the tumor but since the *anatomy* of the lymphatics has been better understood it is appreciated that metastasis to the mandible is by lymphatic route. Nine cases in this series had secondary deposits in the mandible and in each only small nodes were *noted in the submaxillary* and submental areas.

The submaxillary group of nodes are important *They lie in* the area below the mandible where the mandible is crossed by the external maxillary vessels. The trunks *from all groups of nodes* empty into the jugular chain

DIAGNOSIS

Cancer of the lips should be diagnosed early because of its accessibility Unfortunately *early cancer of the lips is not painful* pain is the one symptom that sends a certain group of people scurrying for relief There is little *excuse for cancer of the lips to develop to* over 1 cm in size before proper diagnosis and treatment Hertzler wisely commented No *abnormality in this region should long escape* the attention of an intelligent patient or his friends Keeping in mind the premalig*nant lesions,* as *keratoses* leukoplakia cutaneous horns chronic fissures, epithelial warts and papillomas the diagnosis of carcinoma of the lip should be made early and with ease

Any lesion of the lips that has the appearance of malignancy (ulcer elevation papilloma induration) should have adequate biopsy This is equally true of any benign appearing lesion persisting more than two or three weeks. All lip lesions should be palpated between finger and thumb to ascertain the consistency Firmness to hardness is suspicious of malignancy It has been the contention of some of the lethargic and unscientific that the taking of a biopsy will produce a cosmetic defect or may aid in the dissemination through lymphatics if malignancy is present This is not borne out by the facts The value of accurate and prompt diagnosis far outweighs any such theoretical danger It should be stressed that representative material is essential and can best be obtained at the base or edge of the lesion The pathologist can only pass on the material submitted to him for examination

therefore, give him material typical of the disease. Seventy-nine patients gave a history of having had previous treatment and in only twenty-one, or 26 per cent was a biopsy taken before the treatment they received elsewhere was given Intelligent treatment cannot be advised or administered unless the attending clinician knows definitely what he is treating and the histological grade of the lesion

As the curability and cosmetic end results increase in direct ratio to early diagnosis, it is of great importance that the patient be seen as early as possible This can be accomplished by proper education of the public and the medical profession relative to lip cancer

There is a direct relationship between the size of the neoplasm and the length of time that it has been present when first examined In 26 per cent of the patients the lesion was under 1 cm. in diameter when they were first seen In 32 per cent the lesion was between 1 and 2 cm in diameter in 18 per cent between 2 and 3 cm in 16 per cent over 3 cm. in diameter and in some either half or the entire lip was involved occasionally extending into the cheek Forty seven per cent came in during the first year of the disease, 22 per cent between one and two years, 13 per cent between two and three years, and in 15 per cent the cancer had been present for over three years.

The prognosis and treatment of carcinoma of the lips will not only be governed by the size and histological grade and the duration, but also by the presence or absence of metastases to the lymph nodes. It is therefore imperative to determine if possible the presence of involvement of the lymph nodes. It is estimated that about 50 per cent of normal people have palpable lymph nodes in the submaxillary submental and carotid bulb areas Therefore diligence must be exercised by the examiner to properly interpret the significance of palpable lymph nodes The presence of palpable lymph nodes, their size consistency and mobility are ascertained by the methods described in Chapter I It is well to have the patient flex his chin and explain to him that this position relaxes the muscles, making palpation accurate It is often helpful to hold the patient's head forward with one hand while examining the neck with the other Our routine is to begin by palpating the lip between thumb and finger Then with a finger of one hand in the mouth and the fingers of the other hand beneath the chin and mandible, the floor of the mouth is palpated bimanually starting in the submental region and working backward The submaxillary salivary gland is normally palpable as a soft oval mass beneath the middle of the lower jaw Any hardness within it should be viewed with suspicion until proven negative. The pre- and retrovascular nodes (Fig 172) are best felt by lifting the soft tissues of the submaxillary triangle up over the mandible. In so doing the nodes are brought up beside the mandible and slipped back beneath the fingers, or may be held against the jaw and studied

When the cancer involves the upper lip the pre and postauricular and infraparotid regions must be palpated in addition to the others mentioned.

In all cases, carefully examine the jugular chain which extends from back of the angle of the jaw down to the clavicle along the anterior border of the sternocleidomastoid muscle.

Normal nodes are soft movable discrete, and non-tender If the nodes are involved by a subacute or chronic inflammatory process they are as a rule, tender and firm Acute inflammation may produce large nodes, one to several centimeters in size, painful, fixed, and may be associated with skin erythema and evidence of increased local temperature Acutely inflammed nodes seldom produce problems in differential diagnosis. Acute infection in the mouth may produce involvement of the nodes that complicates large carcinomatous metastatic nodes.

Malignant nodes are at first discrete, movable, elastic in consistency, or hard but as the pathological process continues, the capsule of the node is permeated by the malignant cells with invasion of the neck fascia Round cell infiltration associated with

a chronic inflammation around the node adds fixation and identifies the fact that malignant cells *are invading the* surrounding structure When this occurs, the diagnosis is obvious. In the early cases, there is no absolute clinical method of being certain of the presence or absence *of malignant cells* in the nodes. Small nests of malignant cells in the nodes complicated by the fact that frequently oral sepsis is present, along with ulcerated cancer which also *spreads to the nodes*, will confuse the diagnosis. Not infrequently the nodes at first swell because of infection and then reduce leading the clinician to the dangerous assumption that *there is no associated metastatic cancer* Associated with large fungating infected, and ulcerating lesions, the nodes in the drainage area may be large, firm and tender and in such cases, *it is difficult to determine* whether they are invaded by malignant cells or are the result of infection, or both Such large nodes, present on admission may become reduced or *practically impalpable as the primary* lesion is adequately treated by either surgery or radiation The reduction in the size of the nodes should not lead to a false sense of *security as the inflammatory process may* have been present along with malignant cells. If malignancy is present and obscured by the inflammatory process, the nodes will again become *enlarged. The early removal of all* enlarged firm nodes is imperative to prevent confusion and further dissemination of the tumor, *also to furnish tissue for microscopic confirmation of metastases*, and thereby give an accurate prognosis.

On admission 119 or 44 per cent of this group of patients had palpable nodes *in 52 or 19 per cent, the nodes* were described as being firm, hard, and immobile. In twenty nine cases, the nodes were described as being under 1 cm in diameter in ten between 1 and 2 cm. twenty-one between 2 and 3 cm and in twenty-five cases, they were over 3 cm. in diameter

EVALUATION AND CLASSIFICATION OF CASES

Several factors must be considered *in* planning therapy Carcinoma of the lips, as well as carcinoma in other parts of the body having had *no previous treatment* behave quite differently from those that have been treated with various modalities, as salves, surgery or *irradiation We have found it convenient* to divide cases of cancer of the lips into two groups those that had no previous treatment before consulting our clinics, and those that had had previous treatment. *In consulting the* accompanying charts, it will be noted that patients that had had no previous treatment *showed a preponderance of histological Grade* I and II the lesions were smaller in diameter *and had not infiltrated the lip or adjacent* tissues as much as the ones that had previous treatment The patients that had had previous treatment showed a preponderance of lesions of histological Grades II *III* and IV Patients that have been treated *over* a *period* of months or years often stated that their lesion had persisted or recurred shortly after their *primary treatment. In such cases effort* was made to obtain information from their previous attending physician to determine the amount of irradiation or *type of surgical* treatment that had been given It was not infrequent to find that when such information was obtained the patients had received only a *few* hundred r up to 2000 r over a period of weeks, months, and sometimes years. It is an accepted fact that the application of in*sufficient radiation, repeated* indefinitely only serves to make the cancer more tolerant to that form of therapy

TREATMENT

In discussing the treatment of lip cancer it is necessary to consider separately *the treatment* of the primary lesion and the treatment of cervical metastases, if present Also any previous treatment should be evaluated as to its effect on *making the tumor* resistant to

urther radiation or to altering the histological picture.

We concur, in a measure, with others that early and very small lesions of the lips can be eradicated either by surgery or by irradiation. Each of these modalities has its own advantage and should be used according to the case in hand. We will not engage in the extensive discussion found in the literature relative to the merits of surgery and irradiation in the treatment of lip malignancies and their cervical metastases, but will endeavor to give a proper interpretation of the results of surgery and irradiation based on experience in handling the many variables that presented themselves in the treatment of lip malignancy with or without metastasis, as encountered in this series.

SURGERY

Cancers under 1.5–2 cm in diameter that do not infiltrate the lip deeper than 1 or 1.5 cm. on the lower lip upper lip, or in the commissures are eradicated by V-shaped excision as is shown in Figure 173 A and B Care must be exercised that the incision extends well beyond the growth for at least 1 cm on each side. This surgical procedure is carried out in a minor operating room under infiltration anesthesia with very commendable results In suturing the lip after excision of the tumor the muco-cutaneous junction on each side must be accurately approximated to give a good cosmetic and functional result. The fact that it is necessary to give a good margin of tissue on each side of the growth cannot be over emphasized If the growth is of low histological grade and there are no enlarged nodes in the drainage area, routine neck dissection is not done

Lesions of the lower lip that involve the central third or central half and which do not infiltrate the entire depth of the lip (Fig 174), lend themselves favorably to a wide V-excision of a triangular area, as shown in Figure 175, A–D The removal of such a wide section of the lower lip is difficult to close without some form of flap shifting, and even then is apt to make the lower lip short. To overcome these undesirable possibilities the following procedure has been recommended by many years and is now standard

A small triangular piece of skin and mucous membrane, taking in the full thickness of each side of the upper lip is removed [illegible] The base of the triangle extends [illegible] each commissure for a distance [illegible] from the amount of the tissue re[illegible] to half lower lip The mucous memb[illegible] the line is cut a little higher than [illegible] thus it may be brought out and sutu[illegible] that edge, thus reconstructing the l[illegible] skin the vermilion border of the [illegible]ter of The mucous membrane of the [illegible] lip labial sulcus is incised fa[illegible] gvo- on each side to allow shifting [illegible]

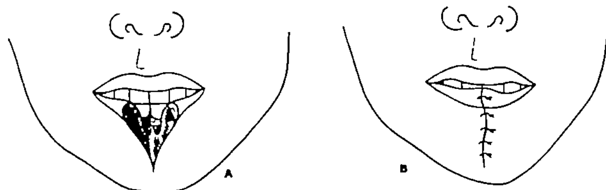


Fig 173

A and B V-shaped excision for removal of small carcinoma of the lower or upper lip and commissure. Wound closed in layers 0 chromic catgut in the submucosa and muscle, interrupted black silk sutures in the skin.



Fig. 174 White male aged 64 years. Squamous cell carcinoma of the lower lip 3 cm in width 1.5 cm in depth. No palpable nodes in drainage area

of the lower lip medially This incision should be made about ¼ inch from the gingiva leaving sufficient mucous membrane for suture.

The right side of the wound is closed (Fig. 175C) the mucous membrane is approximated by interrupted sutures of 00 chromic catgut on an atraumatic needle. Similar sutures are used in the muscle and the skin is closed with black silk interrupted sutures. The mucous membrane of the gingivolabial sulcus is then approximated with interrupted sutures of 00 chromic catgut The left side of the upper lip is closed and the lower lip closed in layers, as just outlined for the upper lip

Neoplasms of the lower lip involving the

A

B

C

D

Fig 175

A. V-shaped excision of tumor with substantial margin on each side A triangular area is removed from each side of the upper lip Transverse incision is placed just beneath the mandible The mucous membrane is cut longer at the lower edge of the upper lip triangles to be used in covering raw surfaces reconstructing vermilion border of lower lip as shown in Fig B

B Right side of upper and lower lip closed re forming right commissure

C The gingival and buccal mucous membranes are sutured with interrupted fine catgut sutures The long strip of mucous membrane from the triangular area of tissue removed from the upper lip, sutured at the angle of the lower lip adequately covering all the raw surfaces V-shaped defect is closed in layers Fine catgut is buried beneath mucosa and in muscle, and interrupted silk sutures in the skin

D All incisions closed



PLATE III

A. Three squamous cell carcinomas, lower lip developing from keratosis. Lesions present 8 months.

B. V-shaped surgical excision, Estlander flap from upper lip suprahyoid neck dissection, nodes positive no recurrence. Good cosmetic results.

C. Squamous cell carcinoma, upper lip unsuccessfully treated elsewhere on two occasions with irradiation.

D. V shaped surgical excision Abbe pedicle flap from lower lip. No recurrence good cosmetic results.

E. Extensive squamous cell carcinoma involving left side of lower lip, of 8 months' duration. Hard lymph nodes in left submaxillary area.

F. Excision of tumor with pedicle graft from upper lip and cheek. Neck dissection lymph node positive some edema in left cheek one month following operation.

central third or half and extending deep into the lip (Fig 176), perhaps as far as the jaw, requires a still more extensive procedure (Fig 177 A and B) Often there is a surrounding



Fig. 176. Squamous cell carcinoma involving the middle third of the lower lip persistent after previous irradiation. The disease extends into the depth of the lip. At the edge there is a zone of thickened indurated tissue on all sides.

zone of induration simulating an inflammatory reaction and, when palpated between the fingers, is found to be tender thickened, and firmer than normal. Malignant cells are present in this peripheral zone, demanding excision of this zone with the tumor, giving a wide margin Often these patients give a history of having had radiation over a long period of time In order to give an adequate margin all the way down the lip, a square or rectangular area of tissue is removed

Here again the lower lip will be markedly shortened Small triangles of the upper lip are excised and discarded The mucous membrane at the base of these triangles is brought out and sutured to the skin for a new vermilion border The mucous membrane in the gingivo-labial sulcus on each side is incised lateralward sufficiently to allow the edges of the lower lip to be brought together The insert shows how the straight lower border of the defect is converted into a W by the excision of a small triangle on each side When these two extra incisons in the chin are closed, the former rectangle becomes a triangular one

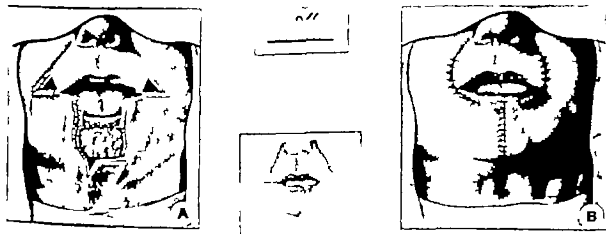


Fig 177

A. Excision of a large tumor leaving a square or rectangular defect. A small triangle of tissue is removed from each side of the upper lip and the mucous membrane of the lower edge of this defect is brought out and sutured to the skin to re form a new vermilion border These triangles are closed in layers with 0 chromic catgut in the submucosa and muscular layers and interrupted black silk in the skin. It remains now to close the rectangular defect in the lower lip. Lower insert outlines removal of a small triangle from each side of the chin to aid in converting the rectangular defect into a triangular one Upper insert shows the method of suturing mucous membranes to the skin edge.

B All wounds are closed in layers using 0 chromic catgut interrupted sutures in the mucosa and muscle and silk in the skin.

which can then be approximated in a straight line. (Figure 175 D)

Cancer involving the lateral third of the lower lip and extending deeply into the lip

requires a somewhat different surgical procedure (*Fig 178 A and B*) Such lesions require wide rectangular excision as illustrated in Figure 179 *A B and C* *The base of this* defect is converted into a W and then closed as in the above-mentioned procedure



Fig. 178

A White male with a persistent squamous cell carcinoma of the left half of the lower lip following irradiation therapy

B Photomicrograph of squamous cell carcinoma of lower lip

The triangular defect is then filled with an Estlander's flap turned down from the upper lip and cheek. The triangle is cut as illustrated the incision from near the ala of the nose stops to within 1 cm of the vermilion border of the lip leaving a narrow pedicle for the orbicularis oris artery to supply circulation *to the entire* triangular flap The triangle includes skin muscle and mucous membrane It is then rotated through 180 and fitted into the defect in the lower lip All incisions are closed in layers and the mucous membrane of the raw edges of the flap are brought over and sutured to the skin creating a new vermilion *border in* the center of the lower lip.

Figure 180 illustrates the authors modi modification of the Estlander triangle for rectangular defects.

Cancers that have been insufficiently treated by irradiation electrosurgery or surgery and involving the entire lower lip down to the mandible, are removed with electrosurgery with no thought of immediate closure of the defect The wound is left to granulate and cicatrize the mucosa to the skin. After a period of six months to a year to insure against the possibility of recurrence the lip is reconstructed by a tube or pedicle flap from the chest wall or the neck (see Chapt. XXI)

Lesions of the commissures, when permitted *to grow either because of uncooperation of the* patient or insufficient treatment, may involve the upper and lower lip and extend out along mucosa and skin into the cheek (Fig 181) are difficult to manage. They are best treated by a combination of modalities. *A thorough* course of high voltage x ray is administered A total dose of 6000 r measured in air is reached Nevertheless, it is not aimed to eradicate all of the disease since electrosurgical removal will be carried out in six to eight weeks after completion of the irradiation The *irradiation shrinks and devitalizes* the cancer and surrounds it with dense scar tissue making electrosurgical removal easier and safer The tongue and jaws, if possible should be protected by lead or lead rubber filters inserted in the mouth during the application of the x ray The wound is permitted to granulate and cicatrize the mucous membrane to the skin always a slow process due to constant bathing by saliva food and ever present infection

When areas of induration persist and *or if* radio-ostitis develope electrosurgical removal *is called for* The wound is allowed to cicatrize Such defects are closed by a pedicle graft from

the chest or occasionally from the neck, the latter can seldom be used due to the fact that so frequently metastasis has also developed on the involved side, necessitating either supra hyoid or radical neck dissection

to the periosteum and outer table of the bone. On the other hand, the *mandible may* be affected by the lymphatic route through the mental foramen It has been shown that in 22 per cent of normal individuals, that the

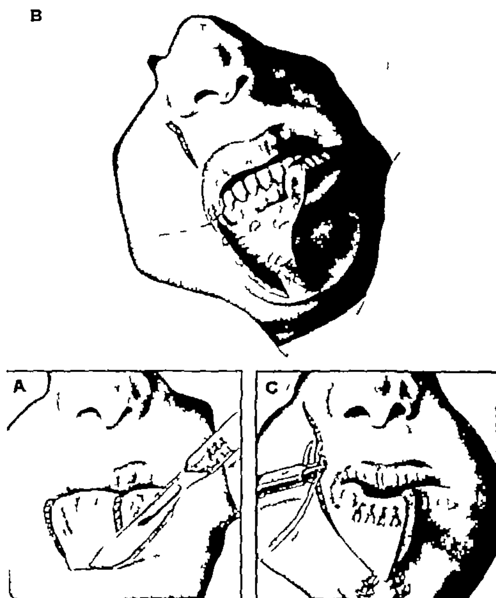


Fig 179

A. Drawing of operative excision of extensive carcinoma of right side of lower lip

B Rectangular defect in lower lip converted into a triangle by two wedge-shaped excisions at the lower border *When these are closed the defect becomes a triangle Estlander triangular flap outlined in upper lip and cheek.*

C Wound being closed in layers. Vermilion border made by bringing mucous membrane to skin edge.

Carcinoma on the lateral third that has been permitted to persist and involve the entire depth of the lip, or having a history of rapid development and of a histological Grade II III or IV may involve the mandible on the same side by direct extension of the lesion

lymphatics from the lateral third of the lip enter the mental foramen, an anatomical pathway by which the malignant process may extend to the mandible Evidence of mandibular involvement by the lymphatic route is toothache or pain in the jaw, and anesthesia

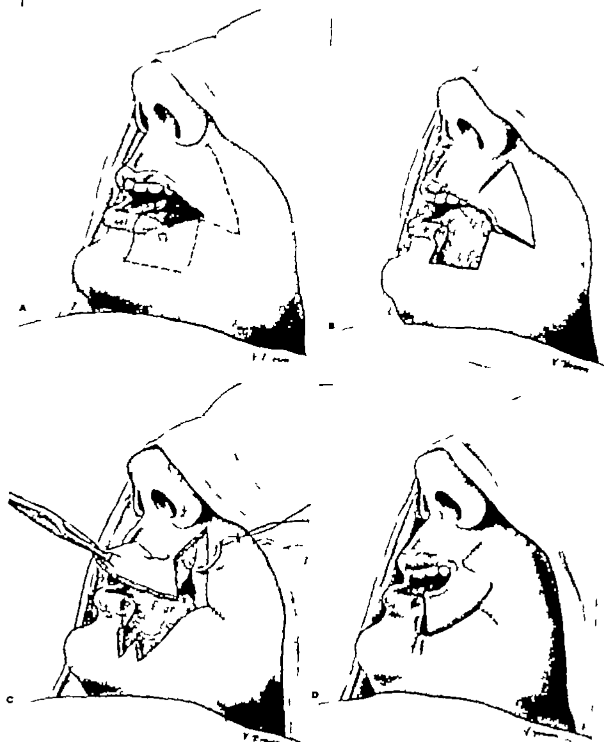


Fig 180 Authors modification of Estlander flaps, useful for lesions such as shown in Fig 1 8 A

A. Carcinoma of left side of lower lip outline of excision of rectangular piece of lower lip according to authors modification of an Estlander flap. In this case it is quadrilateral in place of triangular

B Rectangular defect in lower lip from removal of squamous cell carcinoma Modified Estlander flap cut and ready for rotation into lower lip. (Note that the vertical incision in the upper lip comes to within a centimeter of the vermilion border allowing the orbicularis artery to furnish circulation to the flap)

C Flap rotated through 90 in place of 180° as with the usual Estlander technic The base of lower lip defect converted into a "W" and upper lip defect being closed in layers

D Estlander flap ready for permanent suturing in its new position With this procedure the flap is only rotated through 90° It is a larger flap than the usual Estlander triangle and therefore gives a larger mouth opening "W" incision at the base of defect is closed reducing the size of the defect Upper lip and cheek incision closed

of the lip on the same side. When the mandible is bi-digitally palpated with one finger in the mouth and the other over the mandible pressure will produce pain when metastasis is in the bone. Nine cases (3 4%) of this series had mandibular metastases, in three the entire width of the mandible had to be resected in six, due to limited encroachment, it was necessary to remove only the outer table It is our policy to excise the local lesion and the involved area of bone en bloc, together with the lymph node-bearing areas on the same side of the neck Figure 182 A and B illustrates a case in which the patient had a rapidly developing carcinoma, Grade III with pain in the jaw and anesthesia of the lip on the involved side X ray showed a radiolucent shadow in the left side of the mandible.

The upper lip is less frequently involved by malignant disease, as compared with the lower lip, but when the seat of cancer produces problems of reconstruction somewhat more complicated than the lower lip Small lesions may be excised with the same facility and cosmetic results with the V shaped excision as demonstrated in Figure 173 A and B

If the deformity is to be large, producing considerable contraction of the upper lip following excision of a tumor and closure the method of Abbe is utilized with a pedicle flap turned up from the lower lip (Fig 183A to D) A few interrupted sutures of fine chromic catgut are used in the muscle and the mucous membrane and the skin is approximated with interrupted fine black silk The patient is fed through a drinking tube for twelve or fourteen days. Then the pedicle is cut and any further cosmetic reconstruction accomplished as necessary This method is particularly applicable to neoplasms of the upper lip 1.5-2 cm in diameter and the lower lip is somewhat redundant Figure 183 E and F shows the cosmetic results following the utilization of this procedure.

Malignant growths involving the vermilion border of the upper lip or skin of the upper lip infiltrating a large area will when removed cause disfigurement the lip is reconstructed by the method of Denonvilliers or Davis-Ivy Both procedures have been utilized with good cosmetic results The method of Denonvilliers consists of constructing two vertical flaps through the full thickness of the cheek with a pedicle below, after the growth has been removed as shown in Figure 184 A and B The lateral incisions begin from the lower border of



Fig 181 The patient, a 50-year-old white male gave a history of a lesion on the left commissure for a period of thirteen years Ointments and salves had been used also the tumor had been inadequately treated with "electric needle" on several occasions. Examination revealed half of the lower lip and a third of the upper lip to be involved with the tumor extending well into the left cheek. There were metastases to the nodes in the submaxillary and jugular chain Biopsy showed squamous cell carcinoma, Grade I. The lesion was treated with irradiation the patient later refusing electrosurgical excision and neck dissection. He expired seven months later from neck and lung metastases.

the mandible and extend slightly above the ala of the nose, and the internal border of the flap is the margin of the defect in the upper lip A diagonal incision is made from the upper angle of the defect to the lateral incision making an obtuse angle which permits the flaps to oppose each other more accurately The flaps are sutured in the midline beneath the nose the mucous membrane lining the flaps is arranged to form the vermilion border Since the flaps contain the whole thickness of the cheek, at first the lip appears thicker but

after a period of months thins to give a good cosmetic result.

Another useful procedure for reconstructing the upper lip after extensive removal of the mucous membrane lining the vertical limb on one side of the wound is taken down. Two flaps are made, one by two horizontal incisions, the lower extending from the com-



Fig 182

A. White male aged 61 years with a lesion 2 cm. in diameter lateral third lower lip history of rapid development and "toothache" Biopsy undifferentiated squamous cell carcinoma, Grade III Anesthesia over the lower lip left side X-ray examination revealed destruction of an area of the mandible Lymph nodes in the left submaxillary gland area were palpable and when removed, showed cancer Treatment V shaped excision lip lesion resection area mandible suprahyoid neck dissection.

B Photomicrograph showing invasion of bone

malignant lesions is the Davis-Ivy method quoted by Horsley and Biggers (1937) (Fig 185 A–C) Following complete removal of the tumor the wound is temporarily closed by approximating the mucous membrane to the skin on each side. After a period of ten days, missure laterally and the other from the ala laterally into the cheek for a distance of one-half the deformity in the lip. The incisions extend through the skin subcutaneous tissue down to the muscle The lateral border of this flap is incised, connecting the horizontal in

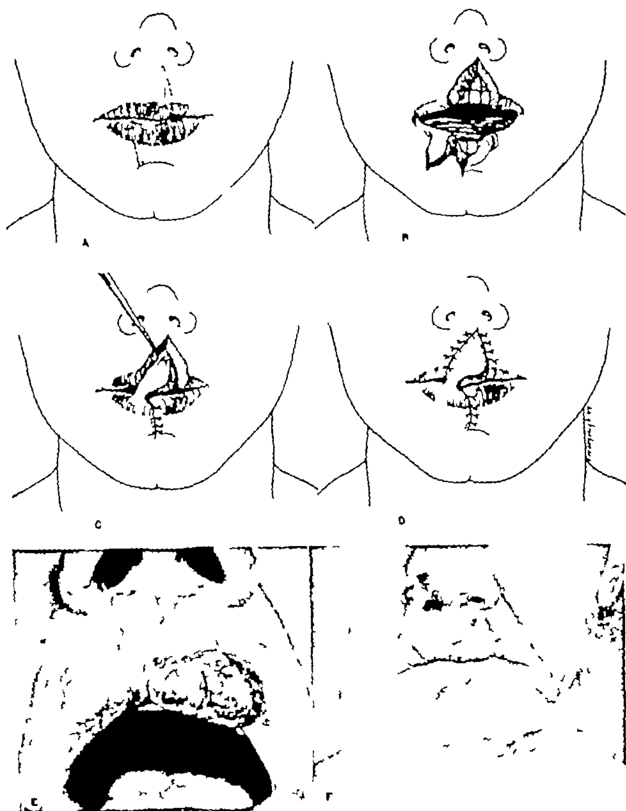


Fig. 183 Operation of Abbe for removal of tumor of upper lip by V-shaped excision with repair using triangular flap from the lower lip

A. Excision of tumor, middle third of upper lip, by V-incision.

B "V" flap is made in the lower lip. On one side the flap remains attached with sufficient tissue to give adequate circulation usually a transverse artery is found just below the vermilion border of each lip

C Flap from the lower lip is brought into defect in upper lip, the triangular deformity in the lower lip being sutured with interrupted black silk.

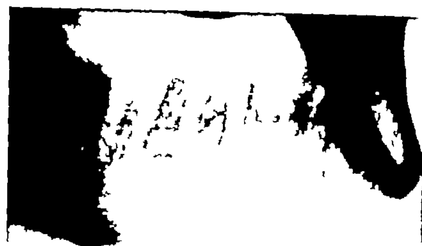
D The operation completed by suturing the flap from the lower lip into the defect in upper lip The flap is cut loose from the lower lip after a period of ten days during which time the patient is fed through a large drinking tube

E. White man with carcinoma upper lip recurrent after x-ray therapy

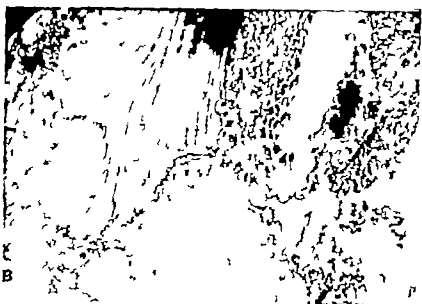
F Result after Abbe operation.

after a period of months thins to give a good cosmetic result

Another useful procedure for reconstructing the upper lip after extensive removal of malignant lesions is the Davis-Ivy method quoted by Horsley and Biggers (1937) (Fig 185 A–C) Following complete removal of the tumor the wound is temporarily closed by approximating the mucous membrane to the skin on each side After a period of ten days, the mucous membrane lining the vertical limb on one side of the wound is taken down. Two flaps are made one by two horizontal incisions the lower extending from the commissure laterally and the other from the ala, laterally into the cheek for a distance of one-half the deformity in the lip The incisions extend through the skin subcutaneous tissue down to the muscle The lateral border of this flap is incised connecting the horizontal in



A



B

Fig 182

A. White male aged 61 years, with a lesion 2 cm. in diameter lateral third lower lip history of rapid development and "toothache" Biopsy undifferentiated squamous cell carcinoma Grade III Anesthesia over the lower lip left side X-ray examination revealed destruction of an area of the mandible Lymph nodes in the left submaxillary gland area were palpable and when removed showed cancer Treatment V shaped excision lip lesion resection area mandible suprahyoid neck dissection.

B Photomicrograph showing invasion of bone

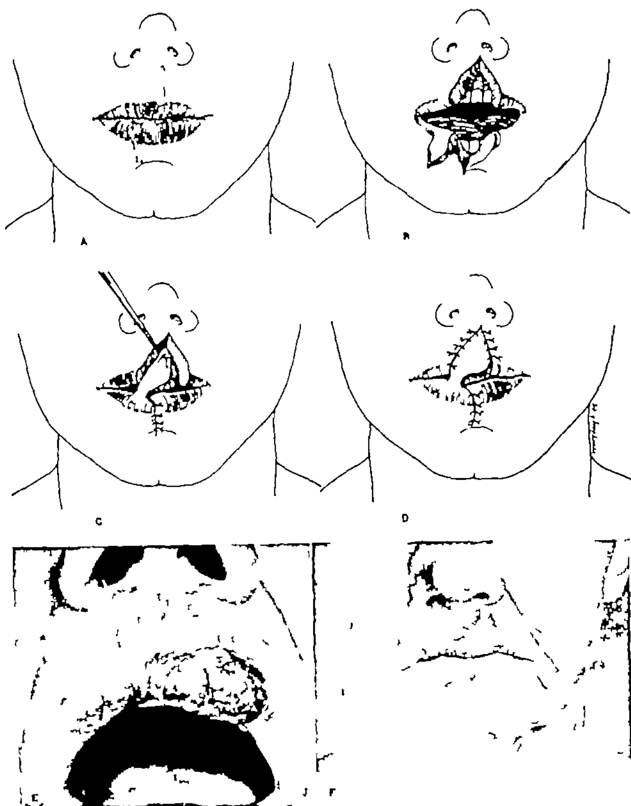


Fig. 183 Operation of Abbe for removal of tumor of upper lip by V-shaped excision with repair using triangular flap from the lower lip.

A. Excision of tumor, middle third of upper lip, by V-incision.

B "V" flap is made in the lower lip On one side the flap remains attached with sufficient tissue to give adequate circulation usually a transverse artery is found just below the vermillion border of each lip.

C Flap from the lower lip is brought into defect in upper lip the triangular deformity in the lower lip being sutured with interrupted black silk.

D The operation completed by suturing the flap from the lower lip into the defect in upper lip. The flap is cut loose from the lower lip after a period of ten days, during which time the patient is fed through a large drinking tube.

E. White man with carcinoma upper lip recurrent after x ray therapy

F Result after Abbe operation.

cisions, and the skin and subcutaneous tissue are dissected from the muscle and mucous membrane, beginning laterally and extending medially which will form the interlining covering the defect *A second flap is made in the cheek extending down over the angle of the mandible onto the neck, by* two vertical incisions of a sufficient width to cover the defect as is shown in the dotted line. The vertical flap is sutured in place with fine silk or horse hair sutures. The mucous membrane that had been previously prepared forms the vermilion

defect is corrected by making a triangular with the base downward and the apex *tending up toward the ala of the nose,* the is turned down into an incision just above vermilion border of the upper lip and sutu with interrupted black silk lowering the a of the mouth. The method is also utilized w the angle of the lip is depressed. In this cas triangular flap is made which includes the a depressed at the angle of the mouth *the fla* transferred into a horizontal incision at *lower edge of the vermilion border of the lo*

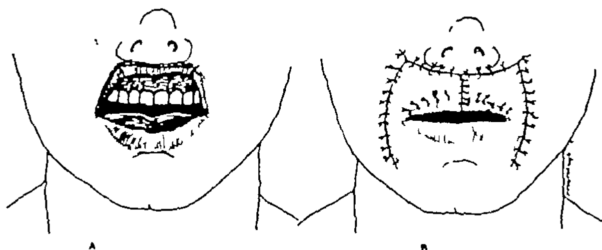


Fig. 184

A. Denonvillier's operation for correction of large deformity of upper lip. Vertical flaps are made through full thickness of the cheek on each side with a pedicle below The external incision of the flaps extends from level of the ala of the nose to the lower border of the mandible Transverse incisions are extended from the up *border of the deformity to meet the collateral incisions forming an obtuse angle*

B The flaps brought together in the midline and sutured together with black silk. The vermilion border of lip is reconstructed by dissecting the mucous membrane upward from the lower area of the flaps. This proced gives a rather good reconstruction, except *the lip is left rigid*

border of the reconstructed lip The vertical incisions over the cheek and neck are closed with interrupted horsehair or fine black silk mattress sutures. This type of reconstructive procedure is satisfactory but time must occasionally *be allowed between the transferance* of the flaps It gives a more rigid upper lip than the method of *Denonvilliers.*

Scars resulting from radiation therapy of small tumors at the commissures, either involving the upper or lower lip that may result in an upward or downward distortion are *corrected by* Szymonowski s methods, as shown in Figures 186 A and B and 187 A and B *If the corner of the mouth is drawn upward* the

lip and sutured with interrupted sutures black silk

TREATMENT BY IRRADIATION

Cancers under 1.5 cm in diameter and n over 4 mm. in depth and of low histologic grade or larger growths in an elderly patien *are often treated by irradiation. (Fig 188 A* (We have treated such lesions with *6000 70* r of *unfiltered* x ray *including a margin of* cm on each side The therapy is given in br ken doses at five or six sittings spaced at tw or three day intervals Our results have show this method is better than if the entire amou of irradiation is given at one sitting It is to l

Fig. 185 Davis-Ivy method of reconstructing upper lip after extensive destruction of a large area

A. After tumor is removed, the wound is sutured temporarily with re-approximation of the mucous membrane to skin on each side. After a few days, the mucous membrane lining one vertical limb of the wound is again taken down. Two flaps are then cut one made by two horizontal incisions the lower extending from the commissure laterally and the upper from the ala laterally into the cheek for a distance equal to the width of the deformity in the lip the incisions extending through the skin and down to the muscle. An incision is made connecting the horizontal incisions and the skin and subcutaneous tissue are dissected from the muscle and mucous membrane, beginning laterally and extending medially allowing the outline flap of skin to be turned over to form lining of the defect. The second flap is made into the cheek and extends down over the angle of the mandible onto the neck, making two vertical incisions of a width sufficient to cover the defect, as shown by the dotted line.

B The horizontal flap placed over the defect and sutured, forming the lining of the lip. The vertical flap is raised from the cheek to be placed over the first flap forming the skin covering of the new lip.

C. The vertical flap is sutured in place with horsehair The mucous membrane that had been previously prepared forms the vermilion border of the reconstructed lip. The vertical incisions over the cheek and neck are closed with horsehair sutures. This type of reconstructive procedure is satisfactory if the defect is not too large. Time must be allowed between the two operations.

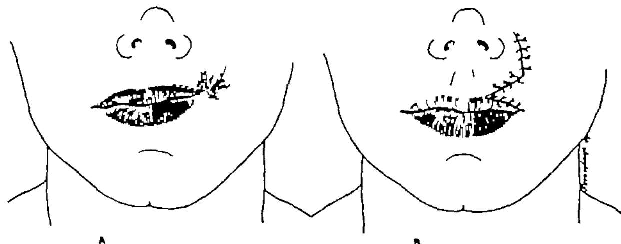


Fig. 186. Operation for upward displacement of the commissure (Szymonowski) due to scars from irradiation or removal of small tumors.

A. A triangular flap is made with the base downward and the apex upward and external to the ala of the nose. An incision is made at the vermilion border of the lip and the triangular flap is turned into it just above the mucous membrane In this manner the commissure is lowered B The edges of the wound are approximated and sutured with fine black interrupted sutures.

relationship of histological grading to lymph node involvement or recurrence (Table 15)

Hayes E Martin reports from the Memorial Hospital in \ew \ork that of all cases of lip cancer without palpable lymph nodes when first seen 8 per cent will sooner or later develop metastases in the lymph nodes In other words, these 8 per cent either had microscopic in volvement on admission or metastases oc curred during treatment of the primary tumor before it was eradicated We feel, therefore that routine neck dissection (suprahyoid) is not indicated in cancer of lip when lymph nodes are not palpable

TABLE 15

LYMPH NODE INVOLVEMENT

Primary Group 180 Cases	
Palpable nodes	75–41%
Neck dissections	53–29%
Nodes resected positive	23–43%
Local recurrence	15–8%
Recurrence in nodes	35–19%
Died of cancer 0 to 7 years	23
Secondary Group 79 Cases	
Palpable nodes	44 55%
Neck dissections	47–59 5%
Nodes resected positive	29–61%
Local recurrence	7–9%
Recurrence in nodes	25–31%
Died of cancer 0 to , years	23

From Table 16 it is apparent that the re currences in lymph nodes increase in direct relation to the higher histological grade i.e the more anaplastic the tumor the greater the percentage of metastases

Also from Table 14 it is evident that the percentage of three-year and five-year salvage is in direct proportion to the size of the pri mary lesion i.e the smaller the lesion the higher the percentage of three-year and five-year salvage.

From these two observations we have formulated the following principles for neck dissection (suprahyoid) in lip cancer

When the lip tumor is under 2.5 or 3 cm in diameter and of low histological grade (Grade I) with no palpable nodes in the submental or submaxillary areas, routine suprahyoid neck dissection is not advised Lip cancers under 2 cm in diameter and of a higher histological grade (II III or IV) without palpable nodes in the submaxillary and submental areas, are not advised to have a routine suprahyoid neck dissection Such patients are observed every two months for the first year and every three months the subsequent year and every four months thereafter for a period of five years at least When nodes enlarge in either of these two groups, suprahyoid dissection is done immediately

TABLE 16

RELATIONSHIP OF GRADE TO RECURRENCE

PRIMARY GROUP (180 CASES)	NO. CASES	RECURRENCE IN NODES
Grade		
I	85–45%	8–9%
II	67 35%	14–20%
III	19–8%	9–47%
IV	9–4%	5–55%
Secondary Cases (79 cases)		
I	22 27%	2 9%
II	37–46%	10–25%
III	13–16%	8–60%
IV	7–9%	5–70%

Lesions over 2 cm in diameter having a *history of short duration with rapid growth* and of histological (rade II III or IV even though no nodes are palpable should have routine suprahyoid neck dissection The mor tality from routine suprahyoid neck dissection as a prophylactic or curative measure is very low and cosmetic results are good. The mor tality from all surgical procedures in this series including a number of very extensive operations, was 1 per cent

Neoplasms of (rade I and over 3 cm in diameter having no palpable lymph nodes in the drainage area should have a routine suprahyoid neck dissection These large can cers, even though of low histological grade are usually long-standing and more likely to have microscopic metastases in the lymph nodes

Malignant growths involving the middle

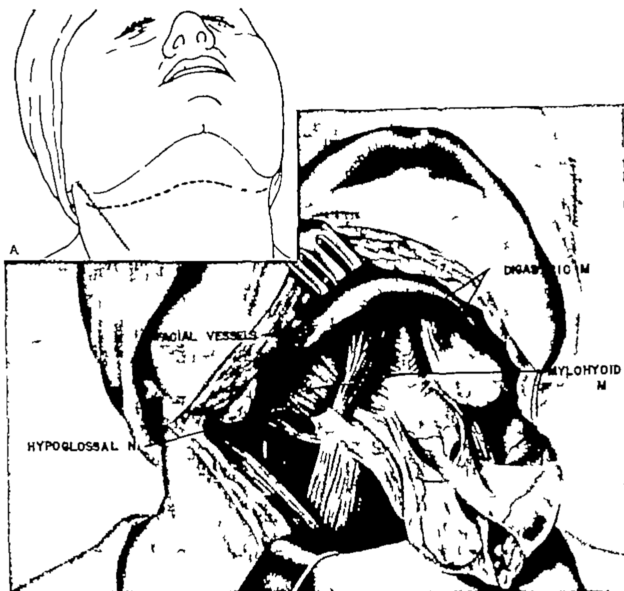


Fig 190. Bilateral suprahyoid block dissection for carcinoma of the lip and cheek. The dissection may be unilateral or bilateral as indicated. For bilateral dissection the incision begins over the mastoid process on one side, curves in a downward direction in the cervical crease to the upper border of the hyoid bone, and then extends to the mastoid process of the opposite side. For unilateral dissection the incision curves up to the midline of the submental region. The skin flaps, including only a small amount of subcutaneous fat, are dissected well above the lower border of the mandible. In bilateral neck dissection, the side that is least involved is dissected first, while the head is turned to the opposite side. The facial vessels, as they pass over the lower border of the mandible near the angle are doubly ligated and divided The fascia over the lower area of the masseter muscle and mandible is dissected downward The superficial cervical fascia is opened at the lower border of the mandible and the contents of the submaxillary triangle pushed downward. The dissection is extended to the anterior border of the sternomastoid muscle exposing the lower pole of the parotid gland Tissues removed are the platysma muscle lower pole of the parotid gland, the submaxillary gland and the lymph-node-bearing fascia. The external jugular vein is ligated as it passes through the lower pole of the parotid gland care being exercised not to injure the mandibular branch of the facial nerve, as it follows along the lower border of the mandible to the angle of the lip It may be identified as it crosses the facial vessels on the lower border of the mandible.

The dissection is begun anew over the posterior belly of the digastric muscle the facial artery and vein are ligated and severed as they emerge from beneath the muscle The submaxillary gland and lymph-node-bearing fascia are now separated from their bed. The lingual artery is identified and its branches that go to the gland are ligated and severed. The hypoglossal muscle is dissected free from the contents lying above it The contents over the hyoglossus and mylohyoid muscle are dissected upward, exposing the submaxillary gland duct which is separated from the adjacent tissues, ligated, and divided The anterior border of the digastric muscle and the remainder of the mylohyoid muscle are cleared of fat and lymph-node bearing tissue.

If the operation is to be bilateral the dissection is carried across to the opposite side after turning the head sharply removing all fat tissue and lymph-node-bearing fascia in the submental area to the lower border of the symphysis of the mandible

Any bleeding points are carefully ligated or coagulated and the wound closed in layers using interrupted subcuticular sutures of black silk and on-end mattress sutures of fine silk in the skin. A small rubber tissue drain is inserted through each angle of the wound below the parotid gland. A snug dressing is applied to eliminate dead space and collections of serum.

third of the lip, with nodes that are palpable on either side, require a bilateral suprahyoid neck dissection. However when the tumor is limited to the lateral third of the lip and enlarged firm nodes are palpable on the side of the growth, the suprahyoid neck dissection is limited to the involved side. When the nodes are found by frozen section to contain cancer the neck dissection should be extended to include the jugular chain of nodes i.e., a radical neck dissection. This is done by one of two procedures the dissection is continued



Fig. 191 Patient white male aged 72 years, developed a lesion on the right upper lip which, according to the report was squamous cell carcinoma and was treated with 3000 r Three months later the patient noted a painful swelling in the right submaxillary area. Admission examination revealed primary lesion healed, as evidenced by a scar on the right side of the upper lip and a diffuse hard swelling in the right submaxillary triangle measuring 4 x 5 cm. fixed to the mandible and tender It must be stressed that since lesions of the upper lip metastasize widely and early neck dissection is required as soon as lymph nodes become palpable

downward to the crossing of the jugular vein by the omohyoid a simpler and less radical procedure (Willy Meyer) or a complete radical neck dissection down to the clavicle is carried out (Halsted & Bloodgood) In the event that positive nodes are found in the suprahyoid resected specimens from both sides of the neck (primary growth in center of lip) a radical neck dissection should be done on both sides. If such a bilateral radical neck dissection is contemplated, it is a safer procedure to the operations six or eight weeks apa have followed this plan of handling c metastases for several years and have rewarded by a substantial number of p living without recurrence, for periods to ten years following such treatment.

Figure 190 illustrates the technic of hyoid neck dissection Fig 167 B sho cosmetic result of suprahoid neck diss Figures 554 556 and 557 Chapter XIX the technic for radical neck dissection

The importance of careful evaluation lymph-node-bearing area at the time initial examination and treatment an temat c follow-up is illustrated by the c Figure 191 a patient treated elsewhere a series of x ray treatments, totalling 3 for a lesion on the right side of the upper six months duration The primary healed but three months later the patie served a painful mass in the right subma triangle

Patients with extensive metastases t side of the neck which may or may n fixed to the mandible or to the surrou structures and measuring from 3–6 c diameter should be treated with irrad to skin tolerance followed by the implant of radon seeds. After the mass is red surgical or electrosurgical excision is c out more advantageously in five or six w The mass is resected *en bloc* with a r neck dissection When the mandible floor of the mouth and other contiguous are adherent to the mass, these structure taken in the block dissection It ma necessary to close the defect by a plastic cedure at the time of the operation (see Ch XIX) or at a later date A pedicle graft the chest may be required the distal end c graft being lined with split thickness gra form a lining for the inside of the c when there is loss of mucosa This is illustrated in Figure 192

For extensive and inoperable metastase efficient method of implantation of inv cervical nodes with radon seeds was devel

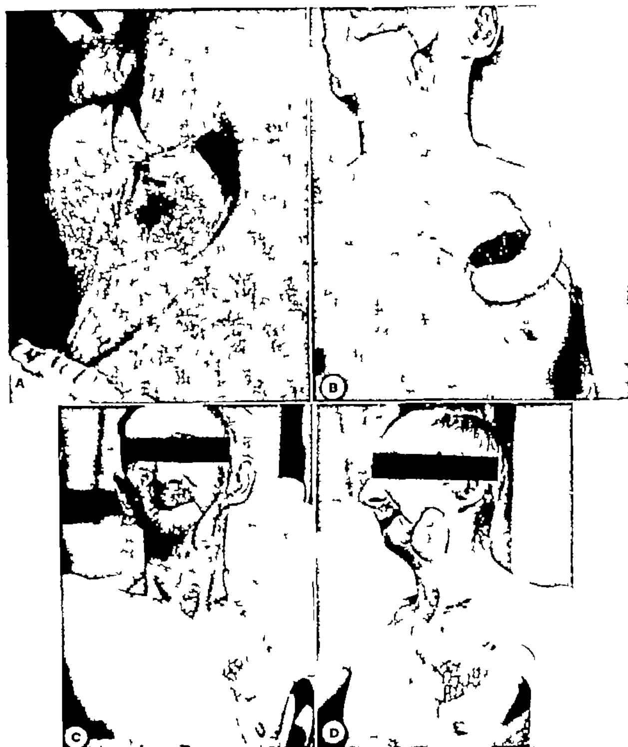


Fig 192 Carcinoma of the left lower lip healed after V-shaped surgical excision. Extensive metastases to nodes and tissues in the left submaxillary area mass attached to mandible

A. Following heavy irradiation (x ray and radium) electrosurgical removal of the metastatic mass mandible, and floor of mouth leaving a large defect in the cheek that extended to hyoid bone and base of tongue

B Tube graft raised from anterior chest wall and walked up to the defect.

C and D Graft closing defect with normal healing. The donor site was covered with pinch grafts. Patient followed over ten years and died of heart disease without recurrence

by Quick and his associates The mass is exposed under infiltration anesthesia for adequate placement of the radon seeds. Areas of necrosis, if present are curetted allowing collapse of the mass, adding to the efficiency of the implantation and preventing abscess. This is a marked improvement over the older method of implanting the nodes blindly

third of the lip with nodes that are palpable on either side, require a bilateral suprahyoid neck dissection. However *when the tumor is* limited to the lateral third of the lip and enlarged firm nodes are palpable on the side of the growth, the suprahyoid neck dissection is limited to the involved side. When the nodes are found by frozen section to contain cancer, the neck dissection should be extended to include the jugular chain of nodes i e a radical neck dissection This is done by one of two procedures the dissection is continued



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Figure 190 illustrates the technic of suprahyoid neck dissection Fig 167 B shows the cosmetic result of suprahoid neck dissection. Figures 554 556 and 557 Chapter XIX, show the technic for *radical neck dissection.*

The importance of careful evaluation of the lymph-node-bearing area at the time of the initial examination and treatment and systematic follow-up is illustrated by the case in Figure 191 a patient treated elsewhere with a series of x ray treatments, totalling 3000 r *for a lesion on the right side of the upper lip of* six months duration. The primary lesion healed but three months later the patient observed a painful mass in the right submaxillary triangle.

Patients with extensive metastases to one side of the neck which may or may not be *fixed to the mandible or to the surrounding* structures and measuring from 3–6 cm in diameter should be treated with irradiation to skin tolerance, followed by the implantation of radon seeds After the mass is reduced, surgical or electrosurgical excision is carried out more advantageously in five or six weeks. The mass is *resected en bloc with a radical* neck dissection When the mandible and floor of the mouth and other contiguous parts are adherent to the mass, these structures are taken in the block dissection. It may be necessary to close the defect by a plastic procedure at the time of the operation (see Chapter *XIX) or at a later date.* A pedicle graft from the chest may be required the distal end of the graft being lined with split thickness graft to form a lining for the inside of the cheek when there is loss of mucosa. This is well illustrated in Figure 192

For extensive and inoperable metastases, an efficient *method of implantation* of involved cervical nodes with radon seeds was developed

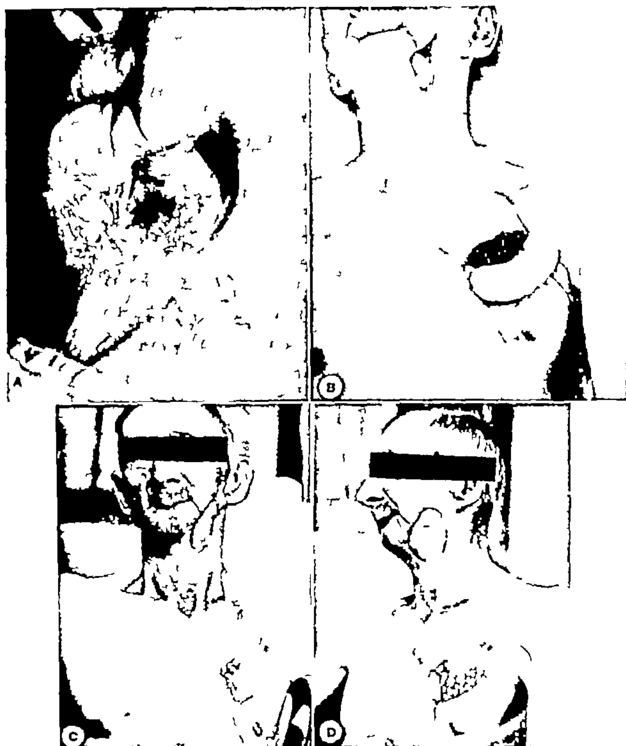


Fig. 192. Carcinoma of the left lower lip healed after V-shaped surgical excision. Extensive metastases to nodes and tissues in the left submaxillary area mass attached to mandible

A. Following heavy irradiation (x ray and radium) electrosurgical removal of the metastatic mass, mandible and floor of mouth, leaving a large defect in the cheek that extended to hyoid bone and base of tongue.

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C and D Graft closing defect with normal healing. The donor site was covered with pinch grafts. Patient followed over ten years and died of heart disease without recurrence

by Quick and his associates. The mass is exposed under infiltration anesthesia for adequate placement of the radon seeds. Areas of necrosis, if present are curetted, allowing collapse of the mass, adding to the efficiency of the implantation and preventing abscess. This is a marked improvement over the older method of implanting the nodes blindly

through the skin, by the latter method blood vessels and nerves in the immediate vicinity may be injured. Good healing of the wound takes place readily. It may be necessary to subsequently re-implant additional nodes. Cases that first appeared hopeless are often carried along for varying periods of time by first treating the involved nodes to skin tolerance with x ray and later implanting them.

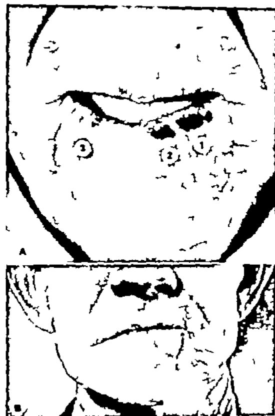


Fig. 193 Multiple carcinomas of the lip.

A. White male, aged 62 years, lesion left side of lip, 8 months' duration; a second lesion medial to first of six months duration; a third lesion on right side 2 months duration. #1 squamous cell carcinoma, Grade I. #2 squamous cell carcinoma, Grade II. #3 squamous cell carcinoma, Grade I. Bilateral simultaneous, wedge-shaped excisions, Estlander pedicle on left side suprahyoid neck dissection, nodes positive.

B. Follow-up showing good functional and cosmetic results. No recurrence.

Each year a number of patients consult the clinics, who have been treated elsewhere with irradiation and on admission present a lingering indurated firm ulcer. Such patients frequently think that they have an x ray ulcer and have been advised all too often by other physicians that they have had too much radiation, a situation seen not only in cancer of the lips, but also in other accessible malignancies. An adequate biopsy is necessary to determine the presence or absence of growth before any type of therapy is considered, for not infrequently malignancy persists, even though clinically the lesions simulate a breakdown of the tissues from the effects of the previous radiation. Such radiation effects are due to obliterating endarteritis and fibrosclerosis. These lesions are resistant to further radiation and should be excised widely and the type of plastic procedure instituted that is necessary to close the particular resulting defect.

A number of patients have been seen with an apparent local recurrence near the site of the original lesion and not actually in the scar. One patient had a growth at a distance from a scar resulting from the excision of cancer of the lip ten years previously. Statistically speaking, the second cancer should be considered separate and distinct from the original and not a recurrence. Such secondary growths are frequently noted in patients having extensive keratoses and leukoplakia. Six patients of this series developed a second cancer in the lip about 2 cm from the primary site, and six other patients had two separate and distinct lesions at the same time, all developing from keratoses or leukoplakia (Fig. 193 A and B).

Other Metastases from Lip Carcinoma

Ewing, in 1940, stated that "metastatic invasion of lymph nodes in lip cancer occurs rather late and shows a close relationship to the size of the lesion and the grade of malignancy. Invasion of submental and submaxillary nodes occurs prior to invasion of deep cervical nodes" (quoted by A. F. Tyler) 1942. Further Ewing states that metastatic nodes develop in 2 per cent of lesions of 1 to 1.5 cm size, early in the course of the disease. He reports that 4 per cent of 276 lesions had metastases from one to seven years after the onset of the illness. There were 13 per cent metastases late in the course of the disease. Broder (1920)

found that there were 11 per cent metastases in Grade I and II and 66 per cent metastases in Grade III and IV He concluded that routine neck dissection was not necessary in grade I carcinoma of the lip Whitcomb (1944) states that metastases to regional lymph nodes occurs in 25 per cent of any series of cases He arrived at this conclusion by compiling the figures of large series reported by Taylor et al (1939) Martin, et al (1941) and Schreiner & Mattick (1933)

The question of distant metastases from any carcinoma is always an interesting one. William S MacComb, reporting from the Memorial Hospital, New York, in July 1942 stated that out of thirteen autopsies, only two had distant metastases, and six out of thirteen autopsies showed regional metastases. Death in these cases occurred from lip cancer or other causes, but having active lip cancer at the time of death. Schreiner states that metastases to viscera almost never occur except in hopelessly advanced cases. He found that the thoracic and abdominal metastases were present in three of seventeen autopsies following death from lip cancer This gives a visceral metastasis of about 17 6 per cent.

FOLLOW-UP

It is quite important that an efficient system for follow up should be planned for each form of cancer and a definite follow-up interval examination to be established, for some types of cancer recur more frequently than others and require closer observation The interval between re-examinations of patients having had cancer of the lips is as follows During the first year every two months the second year every four months the third fourth and fifth years, every four to six months. If the cancer is of Grade III or IV we reduce the time interval as it is known that lesions of these grades recur more often and the recurrence is difficult to control.

END RESULTS

It is of distinct value to establish definite criteria for the diagnosis, treatment and evaluation of the results of treatment of lip cancer Points of diagnosis, evaluation of the lesion, and methods of treatment for the many variables encountered, have been mentioned A study of the end results gives an evaluation of various treatments utilized. This series of 259 histologically proven cases of carcinoma of the lip treated at the tumor clinics of the Johns Hopkins Hospital, the University of Maryland Hospital, and the private practices of the authors, is all-inclusive. It is the policy of both clinics *to accept for treatment all* ambulatory patients with cancers no matter how far advanced, if the patient will accept treatment and is willing to cooperate, even though the treatment is only of a palliative nature. Both primary and recurrent cases are admitted to this study Dr R V Rider biostatistician of the Johns Hopkins Hospital, has directed us in the use of definite criteria to record results of any series of cases for statistical purposes. His method is similar to those followed in the other large clinics of the world. To develop the end result in a given series he only subtracts cases in which an unknown outcome is not due to cancer, or in which the end results are not definitely known because the patient was lost to follow-up after a year's freedom from disease

This series of cases began January 1 1930 and extended until December 31 1944 permitting three-year and five year follow-up periods. The three year and five year periods of freedom from disease are defined as ones in which the patient has remained free from recurrence for at least a period of three years or five years, respectively, following the last treatment

In this study the patients were divided into primary and secondary groups. In the primary group are included only those who had received no previous treatment other than innocuous salves and local applications before consulting our clinics. The secondary group is composed of patients who were treated elsewhere with radium x ray surgery electrosurgery or a combination of these modalities before registering in our clinics. Perusal of the tables will

evidence the fact that the primary group has by far a more favorable prognosis.

It has been stressed previously that there is a definite relationship between the size of the lesion and its curability, as expressed in percentages in Table 14. In the primary group of 180 cases 74 or 41 per cent, were under 1 cm. in diameter, and there was a 95 per cent non-recurrence after five years. In the slightly larger lesions from 1–2 cm in diameter (60 cases, or 33 per cent of the group) the five-year salvage dropped to 80 per cent. The results in the lesions that were over 3 cm in diameter and ofttimes involving half or more of the lip showed the five year non-recurrence was only 41 per cent. Similarly in the secondary group the size of the lesion predicts the non recurrence rate. There was only one lesion smaller than 1 cm. in diameter. When the cancer was between 1 and 2 cm in diameter the five-year non-recurrence rate was 71 per cent, and when the growth was between 2 and 3 cm. in diameter the five-year non-recurrence rate dropped to 54 per cent. It is interesting to note that when the lesion was over 3 cm in diameter the five year non-recurrence rate was the same as for the lesions of equal size in the primary group namely, 41 per cent. In other words, when the lesion reaches 3 cm or more, the non reccurrence rate is the same whether the lesions were in the primary or secondary group. It may be assumed then that the first clinician should have adequately treated the patient when the growth was apparently under 1 or 2 cm in diameter and a good non recurrence rate could have been obtained.

Numerous clinicians have pointed out that patients who had previous inadequate treatment are more prone to develop metastatic nodes than those properly treated when seen by the first physician. Table 15 shows that palpable nodes were present in 75 or 41 per cent of the primary group. In the entire primary group it was deemed advisable by the surgeon to perform neck dissections in 53 or 29 per cent. In 14 per cent of the cases that had positive nodes at operation no palpable nodes had been observed on repeated preoperative examinations of the neck, the criteria for neck dissection being a rapidly growing tumor of short duration and of a histological Grade III or IV. Of the patients in this primary group that had a Grade III or IV lesion fifteen, or 8 per cent developed a local recurrence at some time following their initial treatment. Local recurrence or recurrences in the nodes, were treated as previously outlined. There were twenty three cancer deaths (12.6 per cent) in this series of 180 cases. The deaths occurred from one day to seven years.

In the secondary group of cases, as shown in Table 15, forty four, or 55 per cent, had palpable nodes, and it was deemed advisable to do neck dissections in forty-seven cases, or 59.5 per cent. Not all patients who had neck dissections had palpable nodes prior to operation. Nodes that were removed during the neck dissections were positive in 61 per cent. Nine per cent of the patients in the secondary group developed a local recurrence, and 31 per cent had recurrence in the nodes in the drainage area. Twenty three patients (29.1 per cent) of this group of seventy-nine cases died of cancer the deaths occurring one day to seven years after they were first seen in the clinics.

Table 16 illustrates the relationship of the histological grade of the tumor to recurrence in the nodes. This relationship has been stressed by students of oncology for many years. In contrasting the percentage of the various grades in the primary group, 48 per cent were of Grade I. There was a recurrence in the cervical nodes in 9 per cent. In the secondary group only 27 per cent were of Grade I and, of those, two or 9 per cent developed a recurrence in the nodes. This emphasizes the fact that Grade I tumors are slow in developing recurrence in the nodes and also stresses the fact that patients that have had previous treatment have a lower percentage of Grade I types of tumors. It will be noted that groups II, III and IV comprise the greater percentage of patients in the secondary group with an expected high per

centage of recurrences in the nodes. This fact was stressed in the discussion of treatment.

Table 17 further substantiates the relationship of the histological grade of the tumor to curability As is shown in the 107 cases of histological Grade I, there was 93 4 per cent three-year non recurrence, whereas, in Grade III, the three-year salvage had reduced to 45.5 per cent and 38.2 per cent in Grade IV

TABLE 17

RELATIONSHIP OF GRADE TO CURABILITY

GRADE	NO. CASES	3 YEAR CURE
I	107	93 4%
II	104	81 4%
III	32	45 5%
IV	16	38 2%

TABLE 18

END RESULTS ALL CASES TREATED

TOTAL NUMBER		NUMBER 3 YEAR CURES	NUMBER 5 YEAR CURES
259		74 5%	70 1%
PRIMARY GROUP			
180		76%	72 1%
Surgery	72	93%	89%
Irradiation	69	81%	79%
Combined	39	58%	51%
SECONDARY GROUP			
All Methods	79	66%	64%

Consideration must be given to many variables when an evaluation is made of the end results. These *end results must be based* on three and five year non recurrence, deaths from surgical procedures or treatment, cosmetic results, and the choice of a safe treatment for the individual patient and what is most economical for the patient. Table 18 illustrates the end results in 259 cases in this series that have been carefully followed over a period since 1930 It must be stressed again that early exact diagnosis should be made with an evaluation of the tumor and the patient's condition The *treatment that will* completely eradicate the disease promptly is the most efficient. The three-year non recurrence in the entire series was 74.5 per cent. The five year non-recurrence was 70 per cent. It will be noted further that in the primary group of 180 cases, there was a 76 per cent three-year non recurrence, and a five-year non recurrence of 72 per cent as contrasted to the secondary group of seventy nine cases with a 66 per cent three-year non-recurrence, and 64 per cent five year non recurrence.

In a limited number of patients that were treated with surgery, as outlined previously, the three-year non recurrence was 93 per cent, and a five year non recurrence was 89 per cent Another group of 69 cases treated with irradiation had a non-reccurrence after three years of 81 per cent, and after five years of 79 per cent. *These figures tend to show that* surgery offers a 10–12 per cent better result than treatment with irradiation In these two small groups of cases, treatment was selected after the evaluation of the lesion and a choice made according to what was thought best for each individual patient. There was a third group of thirty nine patients in whom it was necessary to have combined treatment of irradiation and surgery, because of the extent of the tumor A three year non-recurrence was obtained in only 58 per cent of these patients and a five year non recurrence in 51 per cent.

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Chapter VII

BENIGN TUMORS AND PREMALIGNANT LESIONS OF THE ORAL CAVITY

This chapter deals with benign tumors of the oral cavity except of the jaws which are described in Chapter X. Benign tumors of the lips were discussed in a previous chapter Since similar benign tumors and premalignant lesions occur in various parts of the mouth, such as buccal mucosa tongue, gingiva, and palate, each type will be taken up separately rather than according to location The importance of benign tumors and premalignant lesions is twofold Benign tumors should be differentiated from malignant ones, both for the patient s peace of mind and also because some benign tumors are apt to become malignant secondly premalignant lesions, such as epithelial papilloma and leukoplakia, should be properly dealt with to prevent malignancy

The mouth is a good medium for the growth of bacteria, a source of inflammatory processes and secondary infection of benign and malignant tumors The various parts of the mouth are also subject to constant injuries by food, poorly fitting dentures and irregular rough teeth. These chronic irritations are apt to excite malignant disease.

BIOPSY

Every benign tumor of the mouth should be removed and carefully studied by a pathologist. A source of potential danger is thereby obviated and a definite prognosis made. If there is any suggestion of malignancy further treatment may be necessary or it may be sufficient to keep the patient under careful observation for an indefinite period. Most small benign tumors of the mouth can be removed for biopsy under local anesthesia in the surgeon s office Total excision is advisable both for complete removal of the tumor and for obtaining adequate material for microscopic study We find an efficient way is to pick up the mucous membrane at the edge of the benign tumor with suitable forceps and then excise with a safe margin, using strong electrosurgical cutting current This controls bleeding and obviates the necessity of stitches. Healing occurs by granulation in two or three weeks with a minimum amount of discomfort. Larger tumors require more elaborate surgical procedures and the operation should be carried out in the operating room, either under general or local anesthesia. The method of choice will depend upon the neoplasm.

Every chronic ulcer of the mouth that is, one lasting over three weeks should be biopsied. Many times in the past cancer has been missed because the patient had a positive serological test for syphilis and it was assumed by the clinician that syphilis was the sole disease Not until lymph node involvement occurred was cancer suspected Every chronic ulcer of the mouth should be palpated with a gloved finger Indurated areas indicate the best site for biopsy a rather simple office procedure carried out with or without anesthesia, depending upon the fortitude of the patient and the type of ulcer Should the edges of the ulcer be vegetated they can be nipped off with biopsy forceps (see Introduction) with little discomfort. Flatter and more sensitive ulcers, where the mucous membrane is not elevated, require local anesthesia by injection of procaine or novocain

LESIONS DUE TO TRAUMA

Hypertrophy of the mucous membrane of the oral cavity which is a reaction to repeated trauma such as biting or malfitting dentures, is not uncommon and must be differentiated from true tumors. Such hypertrophy may occur on the buccal mucous membrane or

gingiva Malfitting dentures rub the gingiva, causing tissue reaction comparable to callous formation on the hands and feet from chronic injury (Fig 194) The hypertrophy may take the form of a round, soft, lobulated lump of *varying size from a few millimeters to a centi* meter and a half on the buccal mucous mem brane where pressure does not distort it. On the gum, however, especially beneath a mal-fitting plate, the hypertrophied mucous membrane takes on an elongated, sessile to pedun culated, appearance varying in width from 4 or 5 mm to 1 cm, and varying in length from a centimeter to extensive lesions appearing almost like supernumerary gums running along *half of the upper or lower jaw Occasionally* the entire upper or lower gingiva is covered.



Fig 194 Hypertrophy of mucous membrane of the undersurface of the upper lip and cheek from irritation by malfitting denture.

These pseudotumors are covered with nor mal mucous membrane and feel quite firm because of the underlying overgrowth of dense fibrous tissue. Occasionally they become ulcer ated. They are danger signals indicating chronic irritation which might continue to cause malignancy *It is not uncommon to note* a rather diffuse wart-like growth on the palate beneath a loose denture. More will be said about this problem under the heading of Verruca.

TREATMENT

The treatment is surgical or electrosurgical excision *If the lesion* on the gum is excised with a scalpel the mucous membrane edges should be undermined and sutured Most of these lesions *however, can be removed with* an electrosurgical cutting current under local nerve block anesthesia Granulation takes place in two or three weeks with excellent healing, so that well-fitting dentures are worn with comfort. The rounded, softer mucous membrane hypertrophies on the buccal surface are excised under local anesthesia with an electrosurgical *cutting current Bleeding is controlled* by touching the vessels with a ball coagulator, *so that a dry sterilized surface remains.* Ordinary mouth hygiene is all that is necessary for postoperative treatment



Fig 195 Fibrous granuloma of the gum. Often spoken of as epulis.

PROGNOSIS

The outlook is good after removal, and if the source of the irritation is eliminated

INFLAMMATIONS

Granuloma of the Gum

The most common inflammatory lesion in the mouth to be differentiated from a tumor is the ordinary granuloma of the gum (Fig 195) *occurring* about the teeth and associated with pyorrhea. Here they appear as soft reddish growths which bleed easily unless covered with mucous membrane *Granulomas on the gum* may be acute or chronic Under the microscope the acute ones of a few weeks duration

appear as ordinary granulation tissue. Indeed they are so vascular that often pathologists make a diagnosis of infected hemangioma, while others will call them vascular granulation tissue. As time goes on, fibrosis occurs. The lesions, although perhaps very large may be covered with mucous membrane simulating an epulis (see below) Chronic fibrosed granulomas can be differentiated from epulis usually clinically by the appearance of the gum and teeth Poor carious teeth and irregular swollen infected gums indicate the true nature of the disease (Fig 196 A and B)

TREATMENT

Improvement of dental hygiene is mandatory, and may be all that is necessary to prevent recurrence of small acute granulomas after excision of the local growth. Larger ones, often 2 or 3 cm. in diameter, require electrosurgical excision under local anesthesia A wide margin should be given The patient is then referred back to the dentist for proper care. In using electrosurgical currents one should be careful not to destroy too much periosteum, resulting in recession of the gums and exposure of portions of the roots of the teeth.

Granulomas on the Tongue

Granulomas on the tongue are caused by biting followed by secondary infection They, too, are vascular and it is often difficult histologically to differentiate between an infected hemangioma and a vascular granuloma (Fig 197 A and B) Most of the granulomas of the tongue occur in older children and young adults. There are no symptoms other than the history of the bite and the appearance of a raised lump which bleeds easily Treatment is excision with suture under local anesthesia, or excision with electrosurgery Following electrosurgery the wound granulates, giving a soft, pliable, insignificant scar

Other inflammatory lesions, as aphthus ulcers and traumatic ulcers, are readily diagnosed from the history and appearance. Should any supposedly traumatic ulcer continue for more than two or three weeks, biopsy is imperative.

The most common types of chronic inflammatory lesions of the mouth which require



Fig 196. Large rapidly growing granuloma of the lower jaw surrounding carious teeth.

A. Photograph of patient showing multilobulated tumor with indentation from the pressure of the upper teeth. Pressure of the upper teeth made the tumor grow in large lobules

B X ray film showing many carious teeth and recession of the gingival border

differentiation from tumors are syphilis and tuberculosis.

Syphilis

Syphilis in the mouth may be primary chancre, secondary mucous patches, or tertiary

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Fig. 195 Fibrous granuloma of the gum. Often spoken of as epulis.

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Other inflammatory lesions, as aphthus ulcers and traumatic ulcers, are readily diagnosed from the history and appearance Should any supposedly traumatic ulcer continue for more than two or three weeks, biopsy is imperative

The most common types of chronic inflammatory lesions of the mouth which require differentiation from tumors are syphilis and tuberculosis.



Fig 196. Large rapidly growing granuloma of the lower jaw surrounding carious teeth.
A. Photograph of patient, showing multilobulated tumor with indentation from the pressure of the upper teeth Pressure of the upper teeth made the tumor grow in large lobules
B X-ray film showing many carious teeth and recession of the gingival border

Syphilis

Syphilis in the mouth may be primary chancre, secondary mucous patches, or tertiary

gumma and glossitis. The history and associated symptoms suggest the diagnosis, which is confirmed by positive serology Rarely is a chancre confused with carcinoma both because of the short duration of the lesion and a history of exposure The most important syphilitic lesions in the mouth to be differentiated from cancer are gumma and syphilitic glossitis.

Syphilitic glossitis is characteristic. The tongue is thickened and scarred the papillae are atrophied, so that shiny areas appear here and there. Patches of leukoplakia are scattered over the surface (Fig 198) One form of *chronic syphilitic glossitis* appears almost like a hobnail tongue. Apparently inflammatory processes (gumma) have occurred from time to time with healing which scars and disfigures the tongue, throwing it up into varying sized lumps (Fig 199 A and B) This lesion is serious, as it is susceptible to development of cancer



Fig. 197
A. Granuloma of the tongue.
B Photomicrograph showing marked vascularity and inflammatory reaction



Fig. 198 Syphilitic glossitis Note whitish leukoplakia and atrophy of the papillae on both sides of the tip of the tongue.

The serological test for syphilis being positive clinches the clinical diagnosis. Treatment is treatment of the syphilis itself

Another form of tertiary syphilis of the tongue is the gumma. This begins as a single, deeply placed nodule, situated on the dorsum. Necrosis occurs with expulsion of dirty foul material, leaving a ragged, overhanging edge. The ulcer is characteristically punched-out and painless. Its importance is differentiation from malignancy Cancer and syphilis, particularly in the tongue, are associated frequently so much so in fact, that simply because the serological test for syphilis is positive does not mean that cancer is not associated with the syphilis. If after two or three weeks of antisyphilitic treatment the gumma does not heal a biopsy should be done Palpation of a hard area or nodule indicates the site of biopsy

Chronic Nonspecific Glossitis

The term *glossitis* as glibly used is a wastebasket into which many lesions of unknown

etiology are placed. Non-specific glossitis is a diagnosis made by ruling out other causes.



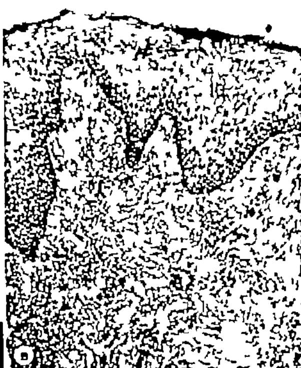


Fig 199

A. Scarred nodular tongue from tertiary syphilis. Notice hobnail appearance caused by marked scarring between the elevations.

B Photomicrograph showing hyperplasia of the squamous epithelium and round cell infiltration. (A and B reproduced from The Cyclopedia of Med., Surg & Specialties by permission of F A. Davis Co.)

Such lesions occur either on the dorsum of the tongue (Fig 200), occasionally in the midline, or along the side (Fig 201 A and B) The ulcers are usually painless and firm with flat or turned in edges the base is fairly clean and they do not bleed easily The serological test for syphilis is negative biopsy shows only chronic inflammatory reaction (Fig 202) The significance of these lesions is the necessity of differentiating from cancer by biopsy Treatment is surgical or electrosurgical excision. Healing is the rule

Median Rhomboid Glossitis

Median rhomboid glossitis (Fig 203) occurs as a painless slightly firm and elevated dull reddish shiny lesion in the midline of the tongue in front of the circumvallate papillae Its etiology is unknown The area rhombica mediana arises from the third and fourth branchial arches (see Chapter II) The duration and symptoms are indefinite Biopsy shows only a chronic inflammatory reaction. Treatment is expectant We have excised this lesion with good healing excision however is not necessary



Fig 200 Chronic glossitis in the form of a small ulcer in the center of the tongue. Note that this is farther forward than the median rhomboid glossitis illustrated in Fig 203

Acute Abscess

Abscess of the tongue is not common. We have seen one patient in the last twenty-five years. The clinical picture is characteristic. There may be a history of injury. Abscess of the tongue may occur apparently spontaneously. The tongue swells rapidly, is exceedingly sore, and painful. It appears red and shiny. The patient is unable to talk or swallow and the swelling may continue so fast as to interfere with respiration. It is often difficult to detect the presence of suppuration because of the exceeding tenderness of the tongue. The temperature in our case was under 100°. The acuteness of the symptoms and signs make the diagnosis. Treatment is incision and drainage; recovery is rapid.



Fig. 201

A. Chronic non-specific ulcer along the side of the tongue.

B. Photomicrograph showing marked inflammatory reaction beneath the mucous membrane which is thickened and hyperkeratotic.



Fig. 202. Non-specific glossitis. STS negative



Fig. 203. Median rhomboid glossitis

Tuberculosis of the Mouth

Tuberculosis of the mouth is always secondary to tuberculosis elsewhere in the body, particularly in the lungs. The infected sputum

contaminates a small break in the mucous membrane and a tuberculous process is set up Of the three chronic ulcers of the mouth, syphilis, tuberculosis, and cancer, tuberculosis is the most painful It is occasionally painless. Tuberculous ulcers may occur on the tongue (Fig 204) gums, mucous membrane, or palate. In the tongue the ulcer is apt to be quite deep with a clean, nodular base and ragged, over hanging edges On the gums, buccal mucous membrane, palate, and inner side of the lips the ulcer is more superficial, the base nodular



Fig. 204 Tuberculosis of the tongue This patient had two lesions one on the dorsum and one on the left side.

and clean. The diagnosis is made by biopsy and x ray film of the chest Treatment is treatment of the tuberculosis itself

AVITAMINOSES

With the increasing cancer-consciousness of the public and the medical and dental professions, more patients are coming to the clinician because of precancerous and other lesions of the mouth which must be differentiated from cancer It is important therefore, to differentiate between benignity and malignancy, first, to treat the malignancy if it is present, and secondly to reassure the patient and the referring physician or dentist that the lesion is not cancer Martin and Koop (1942) feel that many avitaminoses are precancerous. They and others confirm our observations that patients with oral cancers develop avitaminosis because of the lack of proper food intake. It is for this reason that in Chapter I we have emphasized the importance of a well balanced diet in all head and neck cancer cases, administered parenterally, or by oral tube feeding, or by gastrostomy, if necessary

Of interest in this chapter are the early cases of avitaminoses in the mouth, such as perlache, cheilosis, and certain types of papillary atrophy of the tongue and superficial ulcerations of the tongue. These lesions can be diagnosed by ruling out other diseases and a careful study of the patient's dietary habits The therapeutic test is the administration of large amounts of vitamin B complex. Should there be any areas of induration or deep ulceration, or any question of malignancy biopsy is essential.

Treatment consists of large doses of vitamin B complex, preferably in the form of liver extract or Brewer's yeast either in the powdered form or tablets. We usually prescribe a teaspoonful of Brewer's yeast in fruit juice or six tablets of Brewer s yeast four times a day, with meals and before retiring at night. It would seem that the more natural form of vitamin B complex, such as occurs in Brewer's yeast and liver extract is preferable to any of the synthetic and more refined preparations.

During recent months several of our patients having extensive leukoplakia of the mouth have responded well to 100 000 units of vitamin A per day administered orally (see Color Plate V) Further observations are needed to evaluate this treatment.

LESIONS OF UNKNOWN ETIOLOGY

Glossodynia

Painful tongue is a most distressing symptom drawing attention to the tongue which in this age of cancer propaganda creates in the minds of some patients a fear of malignancy Careful examination reveals a normal appearing tongue and mouth A general medical examination reveals normal physical and laboratory findings. In our experience we have seldom seen a

painful, burning tongue (glossodynia) develop malignancy

Treatment is, first of all, reassurance that the patient does not have cancer Secondly high doses of vitamin B complex are prescribed Our experience has been that relief of the pain coincidental with administration of vitamins, is no greater than with reassurance



Fig. 205 Hairy tongue

of the patient. Martin and Koop feel that this disease is due to avitaminosis and report that their patients have been improved by the administration of high doses of vitamin B

Hairy Tongue

Hairy tongue has long been an interesting clinical entity (Fig 205) The so-called *hairs* in the middle of the tongue rather far back on the dorsum are due to elongated papillae The dark brownish to black discoloration is due to the staining by food coffee tobacco etc. among these papillae

The clinical symptoms are none except for the appearance of a dark, thick, hairy-like area on the tongue. From our experience there is no apparent relationship between this disease and cancer

Treatment is good oral hygiene. The hairy area may be cleaned gently with a toothbrush dipped in peroxide solution Long papillae (hairs) may be cut off

Congenital Fissured Tongue

Congenital fissured tongue is similar to hairy tongue but differs in that the hypertrophy of the papillae is general over the surface and the papillae are not long enough to resemble hairs. The long papillae fall apart in rows leaving irregular fissure like lines, similar to the bending over of long ripe wheat. There is no break in the mucosa and no real fissure. The condition is of no pathological significance, but often alarms the patient or physician, especially when the papillae become filled with food and debris, giving the tongue a dirty coated appearance Treatment is proper oral hygiene brushing with peroxide of hydrogen solution is helpful (Fig 206)

Geographical Tongue

Also known as wandering rash, or glossitis areata exfoliativa, this disease is of unknown etiology The main clinical importance is to differentiate the disease from anything more serious and to reassure the patient of its benign and self limited course. The disease usually

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Plate IV

A Hairy tongue, hypertrophy papilla Etiology unknown. Treatment mouth hygiene.

B Tuberculosis of the dorsal and lateral surfaces of tongue. Patient had tuberculosis of larynx and lungs

C Syphilitic glossitis. This must be differentiated from carcinoma of the tongue. Scar on left side resulted from excision of carcinoma.

D Squamous papilloma of area rhombica mediana of the tongue a rare location for papilloma Primary carcinoma in this area has never been reported.

E. Lymphangioma of tongue Developed soon after birth gradually increased until patient was unable to keep tongue in mouth. Weight of tongue bent the soft growing mandible downward, producing malocclusion See text. Treatment surgical excision of lymphangiomatous mass gave good results with no recurrence in two years

F Hemangioma of tongue since birth. Repeated attacks of infection in tongue treated with mild doses of x ray therapy


A


B


C


D


E


F

appears in young adults Thoma states that two children in the same family were affected We have seen none in very young children



Fig. 206. Congenitally fissured tongue. The papillae are unusually long and fall apart, forming what looks like fissures. Actually there is no break in the mucous membrane.



Fig. 207 Geographical tongue. Note multiple foci of origin. There is atrophy of the papillae, appearing as red, slightly depressed areas surrounded by a white edge.

Red patches appear on the tongue of irregular size and shape with white edges. These patches migrate around over the dorsum and coalesce, forming bizarre arbor vitae like patterns hence the name *geographical tongue* (Fig 207) The white edge is due to thickening of the filiform papillae and hypertrophy of the epithelium and the redder portion is due to desquamation of the epithelium, allowing the red underlying vascular submucosa to show through Treatment is reassurance

Epithelial Papilloma

Since the mucous membrane of the mouth is of a squamous cell type, it is not strange that epithelial papillomas warts, or verruca occur here as on the skin (Fig 208) These tumors in

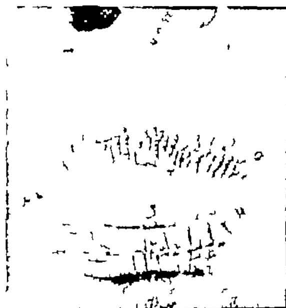


Fig 208 Benign epithelial papilloma of the tongue

a moist medium never become as hard and hornified as on the skin where they are constantly exposed to the drying processes of the air Large verrucas on the lip which extend from the mucous membrane to the skin illustrate this difference On the mucous membrane side, the verruca is softer than on the vermilion border or skin side of the lips Verrucae in the mouth may be firm due to the large amount of keratinized squamous epithelium Their importance, clinically is the possibility of becoming malignant *Papillary* carcinomas of the mouth particularly on the tongue, because of their verrucoid appearance easily could have had origin in a benign verruca. These *true* tumors must be differentiated

from *inflammatory papilloma* or papillitis, inflammation of the *papillae of the tongue*, producing enlargement and swelling. Leukoplakia often takes on a papillomatous formation In such cases leukoplakia must be considered as *definitely on the road to becoming malignant* (see paragraph below)

A papilloma is a proliferation of squamous epithelium developing into folds and, later finger-like projections Within the center of *these papillae is a small* amount of connective tissue carrying blood vessels. The papilloma may be single, multiple, or confluent appearing like large cauliflower condyloma *(Fig 209 A and B)*

The symptoms are those of a small or large growth in the mouth There are so subjective symptoms. Trauma from biting may produce bleeding. *Large cauliflower-like papilloma* can *interfere with normal* speech and mastication, particularly when on the tongue Ewing states that adult papillomas on the tongue arise from leukoplakia syphilis, simple glossitis due to various forms of irritation and therefore the etiology almost duplicates that of lingual carcinoma He further states that "there is a strong tendency toward malignant change which is *indicated by increase in growth* induration, and fixation of the base and ulceration

Butlin states that papillomas of the tongue "*may occur at any age and are not uncommonly congenital." He also describes papillomatous outgrowths of the fungiform papillae.*

Papillomas occur on most any *surface of the* oral mucous membrane tongue palate, inside of the cheek and floor of the mouth Multiple papillomas are occasionally seen on the palate under a *denture* At *times the papillomatous growth becomes so extensive as to exactly* reproduce the shape of the upper denture itself but we have never seen them extend over the edge of the gingiva

Although we have never seen carcinoma of the tongue develop primarily in the area rhomboica mediana *(Rhomboid area in front of the* circumvallate papillae) we have had three patients, two children and one adult with *benign papilloma in this region* (Fig 210 A and B) These tumors presented as papillary soft somewhat reddened elevated growths.



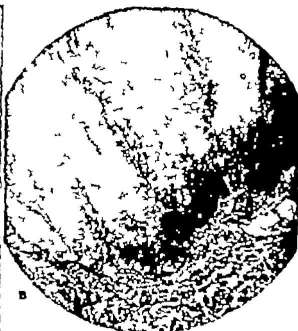


Fig 209

A. Large papilloma involving half of the tongue This type might be called a condyloma of the tongue although *it has no relation to syphilis. (Courtesy F A. Davis Co. The Cyclopedia of Medicine and Surgery)*

B Photomicrograph. Note regular outline of the basal layer There is no invasion of the submucous muscular tissue. *(Reproduced from The Cyclopedia of Med. Surg & Specialties, by permission of F A. Davis Co.)*

There were no other symptoms there was no induration of the base of the tumor and no ulceration They all healed following local excision

TREATMENT

Treatment is surgical removal either with a scalpel or with electrosurgery All papillomas



Fig 210

A. Papilloma of the area rhombica mediana in a boy 17 years of age.

B Photomicrograph showing benign character of the lesion. Note that the basal membrane is intact.

of the mouth should be examined microscopically Small papillomas are removed under local anesthesia with a biopsy forceps and the base thoroughly desiccated (Fig 211) Larger papillomas should be excised with electrosurgical cutting current and allowed to granulate in or excised with a scalpel and sutured Very large condylomas, such as is illustrated in Fig 209 are removed with electrosurgical cutting current, no attempt is made to suture, as the soft pliable scar gives as little interference with speech as when an attempt is made to suture such a large defect in the mucous membrane.

When papillomas occur over a large surface of the palate, apparently from the irritation of a denture, treatment may present a difficult problem Removal of the source of irritation is the first step Sometimes very low, soft, multiple papillomas will disappear or greatly reduce We have treated a number of these



Fig 211 Electrodesiccation of a benign papilloma on the dorsum of the tongue In order to secure deep destruction the electrode should be inserted below the lower border of the tumor down into the muscularis. (Reproduced by permission of F A. Davis Co Cyclopedia of Med., Surg., and Specialties.)

with a radium plaque or intra-oral x ray cone. These papillomas are not very sensitive to irradiation Others have been treated with electrodesiccation In so doing great care must be taken not to destroy the periosteum overlying the thin palatal bone, which may cause sequestration of the thin bone with a perforation into the nose

LEUKOPLAKIA

Leukoplakia is common in the mouth and may be found on the inner side of the lips, gingiva buccal mucosa, palate, and the tongue. Leukoplakia, as its name implies, looks like a white patch Paradoxically, it frequently appears dry although bathed with saliva. The

surface is usually flat and broken by cracks in the squamous epithelium, like crosspatches, giving a mosaic pattern

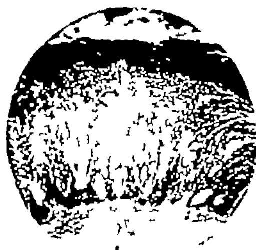


Fig 212. Photomicrograph of area of leukoplakia. Note thickening of squamous mucous membrane and hyperkeratinization at the surface Slight amount of inflammatory reaction beneath

PATHOGENESIS

Leukoplakia is an hypertrophy of the squamous epithelium which under the microscope appears like the hyperkeratosis seen on the skin (Figs. 212 and 213) Squamous epithelium is hyperkeratinized and thickened until it cracks the cause for the mosaic appearance In the mouth where the surface of the mucous membrane is constantly moistened the lesion does not scale off as does hyperkeratosis on the skin This hyperkeratotic process, when on the lip may take the form of leukoplakia on the mucous membrane side, and hyperkeratosis on the vermilion border where it is exposed to the drying effects of the air In studying a microscopic section through such a lip one cannot tell where the leukoplakia stops and the hyperkeratosis begins except for the change in the normal structures of the mucous membrane into the squamous covered vermilion border and onto the skin on the out



Fig. 213. Photomicrograph of leukoplakia. More advanced stage Note downgrowth of rete pegs and more marked inflammatory reaction in the submucous tissue than is seen in Fig 212 Basement membrane is still intact

side. On the mucous membrane side, mucous glands are seen, but no hair follicles or sebaceous glands, whereas, on the skin side, hair follicles and sebaceous glands and sweat glands are in evidence (see Chapter V)

ETIOLOGY

That many cases of leukoplakia are secondary to some form of chronic trauma, is evidenced by the fact that when a chronic trauma, such as tobacco, bad-fitting dentures, or rough, ragged teeth, is removed many of the patches of leukoplakia improve or completely disappear Ewing (quoted above) and Boyd (1947) and others attest to the fact that leukoplakia is evidence of some form of chronic irritation. These authors and others also attribute many cases to syphilis Sturgis and Lund (1934) found clinical evidence of syphilis in 17 per cent of the cases of oral leukoplakia and in 2 per cent of the cases of keratosis of the lip The serological test for syphilis was positive in 27 percent of the cases of leukoplakia and 13 percent of the cases of keratosis of the lip This high percentage may be present in the average dispensary group of patients, but certainly it is not so high in our private practice As a routine, all of our cases of leukoplakia have a serological test for syphilis and the percentage is much lower than quoted in the literature One reason, probably for this low percentage of syphilis with leukoplakia seen in private practice is that a large number of patients come early and the leukoplakia is slight. In the average run of dispensary patients leukoplakia is more extensive and appears like that which is associated with syphilis.

In discussing the relationship of leukoplakia to syphilis with Harry S Robinson Sr., Professor of Dermatology and Syphilology at the Medical School of the University of Maryland, he stated that it is his opinion that very few patients with leukoplakia, exclusive of the tongue, have positive serological tests for syphilis. The reverse is also the case, that is, very few people with known syphilis develop leukoplakia in the mouth J Earle Moore, Associate Professor of Medicine at the Johns Hopkins Medical School, and Physician-in Charge of the Venereal Diseases Clinic of the Johns Hopkins Hospital (personal communication), feels that there is practically no relationship between leukoplakia of the buccal mucosa and syphilis. Leukoplakia of the tongue is different He feels that there is a definite significant relationship between syphilis and leukoplakia of the tongue Moore says that there are not enough statistically significant data to make a definite statement as to the percentage of leukoplakia of the tongue that is on a syphilitic basis.

Several observers have called attention to the possible role of avitaminosis A in the etiology of leukoplakia. As pointed out in the previous discussion of avitaminoses in relation to oral lesions, we have watched large patches of leukoplakia improve with the administration of 100,000 units of vitamin A, daily, by mouth (see Color Plate V) for a period of one to two months.

On the other hand, it is not uncommon to see leukoplakia where there is no evidence of chronic irritation and no evidence of syphilis. These observations have lead us to feel that there is some other underlying biological etiological factor We are convinced that leukoplakia, in many instances, is a precancerous lesion

Mantilla, quoted by William Boyd, states that "of 566 cases of leukoplakia buccalis, including the tongue 32 percent developed carcinoma."

One of our cases pictured in Figure 214 A, B and C illustrates both the lack of a known etiological factor and the premalignant nature of the lesion The patient was an elderly, edentulous woman, near eighty, who did not smoke and who wore no dentures. When she appeared in the dispensary, there was a well developed area of leukoplakia on the right side of the dorsum of the tongue in front of the pillar This was removed with electrodesiccation Her serological test for syphilis was negative One year later she came back with a typical, highly differentiated carcinoma in the scar

CLINICAL BEHAVIOR

These facts have caused us to classify leukoplakia into two groups, or perhaps three, according to the danger of becoming malignant. This classification is entirely clinical and based on our own experience

1 The first group may be called acute leukoplakia, in that the history dates back only a few weeks *or months* (Fig 215 and Color Plate V) These lesions developed rapidly became thickened, and some of them actually ulcerated, or became papillomatous (Fig 216 and 217) These are more apt to become malignant than the second group



Fig. 214

A. Leukoplakia in an 80-year-old woman, who did not use tobacco and whose STS was negative Healed after electrosurgical removal

B Squamous cell carcinoma developing in the scar one year later

C. Photomicrograph shows typical type of squamous cell carcinoma developing in leukoplakia Note hyperkeratinization and pearly bodies

2 Chronic leukoplakia sometimes lasts as long as ten, fifteen, or twenty years. Usually this form is more diffuse and appears as a thin, white film over the surface of the tongue or buccal mucous membrane (Fig 218), and particularly on the palate Tiny red pinhead-sized





Fig 215

A. Acute leukoplakia involving the mucous membrane of the hard palate. Notice thickened piled-up squamous epithelium Note the tiny craterous-like areas which are more frequently seen in the chronic form of leukoplakia on the palate This patient also had squamous cell carcinoma of the floor of both nares, Grade II treated with irradiation about a year previously At that time there was no leukoplakia in the mouth.

B Marked improvement after 1 month treatment with 100 000 units of Vitamin A daily Treatment continued for three months.

lesions may be present, appearing like tiny craters. In the center of this crater is a tuft of capillaries which bleed on the slightest trauma. One of our patients, a doctor in his seventies, could draw blood simply by sucking against the top of his mouth He smoked a pipe with a hole in the top of the stem. The hot smoke flowed over the palate and kept up the irritation. When he changed to a pipe with a hole in the end of the stem, the bleeding stopped, but there was no definite change in the leuko-



Fig. 216. Area of thickened, piled up leukoplakia on the buccal surface just inside the angle of the mouth. This is a common site for leukoplakia. This lesion disappeared under treatment. Returned 4 years later with squamous cell carcinoma in same area

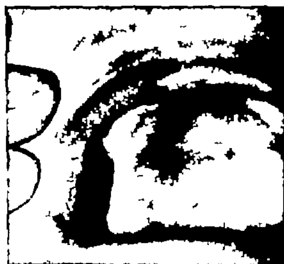


Fig 217 Leukoplakia on upper right gingiva Patient had squamous cell carcinoma removed from the right premolar area with electrosurgery three years previously at another hospital. This was followed by irradiation. STS positive. Patient came to clinic this time with small patch of leukoplakia on the lingual side of the upper right gum. Lesion disappeared following irradiation.

plakia. Another patient was referred because occasionally he would find blood on the top of the tongue. He thought the bleeding was

coming from his tongue. On examination the tongue was perfectly normal but there was a small patch of leukoplakia on the hard palate with several tiny red craterous-like ulcers. Biopsy showed no malignancy Rarely do these long-standing leukoplakias become cancerous

3 A third intermediary group could be established as a subacute type but probably represent the early forms of the more chronic variety and stand intermediary, both in duration of the disease and stage of development between types one and two usually behaving like the latter



Fig. 218. Chronic leukoplakia right buccal mucous membrane. Notice how much thinner the lesion appears than that in the acute variety shown in Figure 215 A. Mucous membrane appears dry granular and in the anterior portion of the lesion somewhat puckered from scar This type is less likely to become malignant than the acute variety

DIFFERENTIAL DIAGNOSIS

An accurate diagnosis of leukoplakia is made after a thorough study of the patient s mouth and surrounding structures. Serological test for syphilis is necessary to rule out this disease If the lesion is fixed or ulcerated or papillomatous, or contains a hard nodule biopsy of an appropriate site should be made to rule out cancer Other lesions of unknown etiology sometimes simulate leukoplakia. Lichen planus (Fig. 219) and psoriasis are among these Psoriasis usually has a more lace-like, shiny appearance, and is much more superficial Lichen planus often appears as small, pinhead to larger-sized white spots, and may be annular or papular A careful dermatological investigation often reveals skin lesions of these diseases. Lloyd Ketron (personal communication) feels that psoriasis never occurs in the mouth and that lichen planus sometimes is present without any skin manifestations. Leucoderma is a rare intraoral lesion to be differentiated from leukoplakia It is flat, smooth and not fissured



Fig. 219 Lichen planus of the left buccal mucous membrane. Note small, pin points of whitish lesion and white streaks which differentiate from leukoplakia.

TREATMENT

Treatment should begin by removing all causes of the leukoplakia, such as ill-fitting dentures bad teeth and excessive smoking On one clinic day two patients appeared with leukoplakic spots on corresponding areas of their tongues. These areas were opposite ragged molar teeth. Correction of the dentistry permitted one lesion to heal the other developed cancer

If the removal of the irritating factors does not cause the leukoplakia to disappear and if definite proof of cancer is lacking the areas are treated in one of several ways. Small patches are destroyed by electrodesiccation or actual cautery under local anesthesia Healing occurs by granulation.

Larger areas on the buccal surfaces, inner sides of the lips, or palate are treated with a radium plaque or intraoral x ray cone Pyott, et al, have described an efficient acrylic applicator with lead protection to the normal oral mucosa With this apparatus, repeated doses of radium can be given accurately to a specified area The usual dose of radium or x ray is 2000 gamma roentgens or 2000 roentgens broken into two or three applications, spaced several days to a week apart. Such a treatment causes second degree blistering of the mucosa which heals in from three to four weeks

Unfortunately certain cases of leukoplakia are resistant to one or the other of these types of treatment Small areas remaining after radiation are electrodesiccated.

Treatment by vitamin A. Recently we have treated a number of cases of acute leukoplakia involving the mucosa of the cheeks and palate with 100,000 units of Vitamin A, orally per day for one or two months with marked improvement or complete regression after a longer time (3–4 months) The therapy should be continued for several months after healing Associated oral sepsis and dental irritations are corrected and tobacco eliminated. This form of treatment has not been in vogue long enough to permit a statistical study

EPULIS

The so-called *fibrotic epulis* or *granuloma* has been mentioned above. Central giant cell and peripheral giant cell epulis are discussed in Chapter X (Tumors of the Jaws)

MELANOMA

Melanoma of the buccal mucous membrane is a very rare lesion The bluish-black discolorations, so common on the gingiva and oral mucosa of the colored race, occasionally become malignant. We have had two cases of melanotic sarcoma of the upper gingiva and one which began in the antral or nasal mucous membrane (see Chapter VIII on malignant diseases of the *buccal cavity*)

FORDYCE'S DISEASE

Fordyce (1896) studied the anomaly which involves the mucous membranes of the lips, cheeks, and occasionally the palate, characterized by discrete yellowish spots.

PATHOGENESIS

This not uncommon occurrence is due to the presence of sebaceous glands in the mucous membrane of the mouth They generally arise at the age of puberty and are more common in men than in women.

CLINICAL FINDINGS

The lesions are very small, isolated or confluent maculopapules of a light yellow color They may occur singly or in small groups of a few, or they may be multiple and confluent, forming yellowish patches on the surface of the mucous membrane They are most frequent in the buccal mucosa opposite the occlusal line of the teeth and also occur along the upper or lower lips, particularly at the junction of the vermilion border and the skin

HISTOLOGY

Sebaceous glands are present in the corium. Occasionally a duct may be visible leading to the surface

TREATMENT

There is no treatment as this condition never leads to any serious complications Its main importance is in differentiating from something more serious and in the cancerphobic patient, reassurance that the lesion will not lead to malignancy

TUMORS OF BLOOD AND LYMPH VESSELS

Angioma

Angiomas of the hemangio- and lymphangiotype are not uncommon in the mouth

PATHOGENESIS

Hemangiomas are formed from endothelial rudiments or from the endothelium of blood

vessels, and the lymphangiomas are formed from the endothelium of the lymph vessels.



Fig 220 Small elevated, purplish hemangioma of the tongue in a teen-age girl Successfully removed with electrosurgery

hemangioma on the face and if so associated there are apt to be direct communications between the external and internal lesion Most hemangiomas of the mouth however are definite entities and appear as purplish red elevated lobulated compressible lesions, sometimes giving the bag of worms feeling They may occur on the gums, buccal surfaces, inner sides of the upper or lower lips, tongue (Fig 220 and 221 A and B) or on the floor of the mouth (Fig 222)

We have had two young adult women who complained of a painless swelling in the submaxillary region Excision revealed hemangiomas of the mylohyoid muscle Another patient, a woman in her middle forties, came with the history of a lump in her cheek of two years' duration appearing rather suddenly She had been treated for obstruction of the





Fig. 221

A and B This 19 year-old girl had three hemangiomas on the tongue one on each side and one on the under surface of the tip of the tongue.

CLINICAL BEHAVIOR

Hemangiomas and lymphangiomas may be congenital or form shortly after birth On the oral mucous membrane and on the lips they appear either as purplish red, discolored areas which are smooth (port wine stain) and are usually direct extensions from hemangiomas on the face The capillary and cavernous variety may or may not be associated with

parotid salivary duct as roentgenographs at the time of the onset showed a calcified shadow in the region of the duct This was taken to be a stone The duct was probed several times with improvement Then the lump recurred and remained stationary

On examination there was a firm nodule about 1 5 x 2 cm in diameter in the right cheek Sialogram showed the lump to be below

Wharton's duct (Fig 344, Chapter XI) On surgical removal through the mouth a thrombosed hemangioma was found Pathological examination (J H H S P #94786) "showed angioma organizing hemorrhage and scarring in muscle. Evidently this patient had had a thrombosis of a hemangioma deep in the buccal fat

When large hemangiomas and lymphangiomas appear in the tongue, the term macroglossia is applied, they are usually congenital (Figs 223 and 224 A–H) They may be



Fig. 222 Hemangioma of the floor of the mouth in a white woman aged 30.

small or attain great size causing the tongue to hang out of the mouth, interfering with feeding The surface of the tongue is roughened, slightly nodular, and shiny Lymphangiomas are the color of normal mucosa or perhaps slightly paler Hemangiomas are of a darker red color Many macroglossias are mixed the main tumor being light and nodular and shiny with here and there reddish, elevated nodules.

Hemangio-endotheliomas may also occur in the mouth and are apt to metastasize (Thoma) Cheyne and Silberstein (1942) feel that this tumor is potentially malignant

HISTOLOGY

On microscopic examination hemangioma may appear to be of the capillary or cavernous variety In the mouth, where the tumor is subject to frequent injury and infection, signs of inflammation are common Thoma states that mitotic figures are often seen and occasionally these tumors grow rapidly infiltrating the surrounding tissue and even bone, with a tendency to recur after excision. We have not observed such rapidly growing hemangiomas.

ROENTGENOGRAPHIC EXAMINATION

Hemangiomas and lymphangiomas involving the soft tissue will show no appreciable



Fig. 223 Congenital hemangio-lymphangioma in a young man, 25 years of age Periodically a low grade infection causes the tongue to swell and become painful Subsides after mild doses of x ray therapy The x ray therapy had no real effect upon the hemangioma itself

change on roentgen examination unless calcification has taken place However, if the lesion has invaded bone an osteolytic shadow is present (Thoma)

TREATMENT

Hemangiomas of the lips in infants are treated with local application of radium (see Chapter III on Benign Tumors of the Skin) Hemangiomas and lymphangiomas in the oral cavity yield best to some form of surgical removal The choice between scalpel or electrosurgical excision depends largely upon the preference of the operator and the size and location of the tumor Small growths in the soft tissues, not involving the gingiva, are excised and the wound sutured Excision of larger tumors, whether with scalpel or electrosurgery,

should always be preceded by ligation and section of the external carotid artery and its branches individually on the same side. Cavernous tumors are so vascular and their vessels so large that electrosurgery cannot be depended



Fig. 224

A and B Congenital hemangio-lymphangioma in a child three years of age. She was unable to talk understandably and has always had difficulty with eating. The tongue has been enlarged since birth; at first it was only about twice the normal size, but has grown progressively until on admission it was quite large, filling the entire mouth and protruding outside for a distance of 7 or 8 cm. X-ray treatment 2 years ago without beneficial effects.

C. X ray illustrates bending of the mandible from the weight of the tongue.

D and E. After removal of the weighty organ, patient could not accurately occlude the incisor teeth.

upon to stop all of the bleeding. The incision, therefore, whether with scalpel or electrosurgery, should be in the normal tissue around the tumor whenever possible. One of our cases of a hemangioma in the floor of the mouth in a woman in her middle twenties is illustrative. An attempt was made to coagulate the tumor under general anesthesia, using a ball coagulator. The surface was coagulated, and immediately as the soft tissue shrank, the underlying large blood vessels were opened with resultant severe bleeding. Since the patient was an adult, the blood vessels had become resistant to radiation. Their walls were rigid and stood open widely, giving the appearance of a honeycomb in cross section. Hemorrhage was controlled by passing through and through sutures, pulling the surrounding soft tissues together. Inflammatory reaction around the

sutures obliterated the entire tumor and gave a very good result

On the other hand, large capillary hemangiomas in the cheeks can be throughly destroyed with electrocoagulation One of our gave no improvement. On examination, the hemangioma was found to involve the right side of the lower lip to the midline and extend back into the mouth to cover most of the right buccal mucosa. There was some extension into

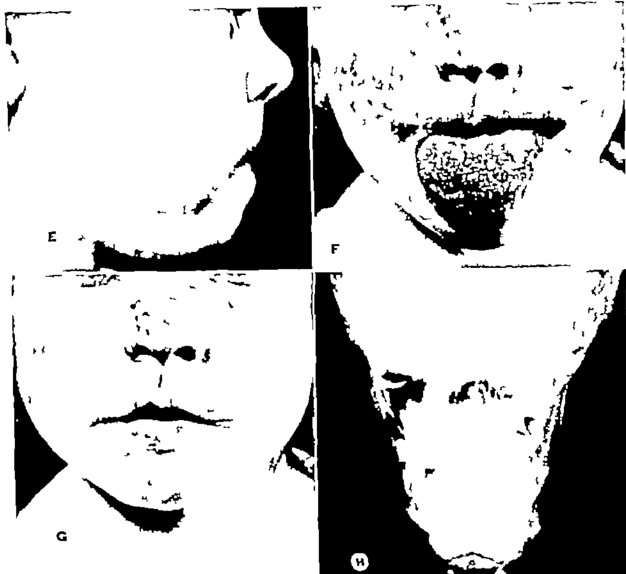


Fig 224

F Result 2 years after surgical excision of all the involved area of the tongue. Pathological report Lymphangioma of the tongue.
G Patient able to close her lips after operation
H. X-ray—2 yrs. after operation—dental occlusion possible.

cases (Fig 225) a young girl of eleven years of age, had a large hemangioma, dating back to birth. In the beginning there was a tiny red spot on the inside of the right cheek which gradually grew but was not treated until she was nine. By that time the growth had extended out onto the lower lip X ray and radium treatment prior to coming to our clinics the right lower gum and a hard pea-sized nodule near the angle of the mouth, otherwise, the tumor felt soft, like a 'bag of worms' Under general anesthesia, the entire tumor was slowly coagulated with a ball tipped coagulator great care being taken to compress the vessels so that the coagulation would close intima to-intima before moving to another

area This case differs from the above since the vessel walls were softer and could be collapsed and coagulated together

The wound healed nicely with some contraction of the right cheek limiting opening of the mouth to a moderate degree. This did not materially interfere with normal function

Five years later she returned with a slightly reddish elevation of the mucous membrane just below the right angle of the mouth and



Fig 225 White female aged 11 years, with large hemangioma involving most of the right buccal mucous membrane and extending down onto the lower lip (See text for complete history) Patient has remained well for 11 years is a trained nurse, and is married.

just inside the vermilion border of the lip about 5 x 10 mm in size This did not represent a true recurrence but rather a vascularization of the scar and was destroyed with electrodesiccation under local anesthesia. One or two phleboliths could be felt in the cheek Eleven years after the first treatment her mother writes that the patient is well a trained nurse, and is married.

Kaessler (1938) and Andrews and Kelly (1932) recommend the injection of sclerosing solution We have had no experience with this method in the treatment of hemangiomas in the oral cavity

Sclerosing solutions vary with various operators from 25 percent glucose (personal communication, Webster R C Jr) to 20 percent quinine dihydrochloride and urethane diluted with an equal part of 2 percent procaine hydrochloride (with epinephrine) (Kaessler 1938) Whatever solution is used, it is injected in very small amounts, 0 1–0 2 cc in each area. A suitable needle is chosen so that the injection can be given submucously or subcutaneously and several deposits of the solution made through the same puncture wound Immediate blanching of the area injected takes place the needle is then advanced, and the next injection so deposited that its area of advancement is next to the previous one.

Pregnancy Tumors

A form of hemangioma occurs on the lip occasionally in pregnant women (Fig. 226) The tumor appears during pregnancy and disappears after the completion of pregnancy We have seen two on the lip and a third in the skin over the sternum Histologically these appear as hemangiomas. Unless there is severe *bleeding treatment is not necessary as the* disease is self-limited

Occasionally congenital hemangiomas about the face and mouth will grow rapidly during pregnancy and recede after the pregnancy has been terminated.

BENIGN CYSTS

Mucocele

Mucoceles are retention cysts occurring as swellings on the lips, buccal surfaces, and undersurface of the tongue

PATHOGENESIS

These cysts are due to accumulation of mucous in a mucous gland the excretory duct of which apparently has been obstructed

CLINICAL BEHAVIOR

The cysts are round or oval translucent and usually have a bluish tinge (Fig 164 Chapter V)

They most commonly occur on the inner side of the lower lip and near the angles of the mouth The size varies from a few millimeters to 1–1.5 cm. Occasionally multiple cysts are found lying together in a small nest

HISTOLOGY

The cysts are lined with epithelium derived from the mucous glands and flattened out by pressure

papillae palatina The size may reach that of a cherry, it is soft and fluctuant, but gives no parchment like sensations, as do the large incisive canal and median cysts, which are surrounded by a thin layer of bone Pressure may discharge semiliquid mucofibrinous drops from the outlets on the side of the papillae. Since these cysts are beneath a rather thick mucous membrane, they are not clear and translucent like mucous cysts.



Fig 226

A. Pregnancy tumor on lower gum.
B Photomicrograph showing vascular nature of the tumor

TREATMENT

Small cysts are readily destroyed by electrodesiccation under local anesthesia. The mucosa overlying the surface is first destroyed the cyst opened and evacuated and the lining desiccated Larger cysts require surgical removal and suture of the mucous membrane

Cysts of the Papillae Palatina

Thoma and Brackett (1936) were the first to describe such a cyst. It forms from the epithelial contents of the incisive foramen instead of the incisive canal This cyst is not surrounded by bone and forms a swelling expanding the soft tissues in the midline of the palate behind the incisor teeth the region of the

ROENTGENOGRAPHIC FINDINGS

The x ray helps to differentiate these cysts from incisive canal cysts which extend higher up into the palate

TREATMENT

Treatment is surgical excision beneath a flap of mucosa which is re-sutured Thoma states that teeth do not need to be disturbed. He also avers that sclerosing solutions may be tried

Ranula

Ranula is a cyst in the floor of the mouth arising either from the sublingual gland or from the submaxillary duct

CLINICAL BEHAVIOR

A slowly developing soft, fluctuating cystic *tumor appears on the floor of the mouth*, usually on one side Large cysts may extend by pressure to the opposite side. As the cyst grows, the mucosa is thinned out allowing the contained clear mucous to impart a bluish tinge The only subjective symptoms are due to the size of the tumor which raises the tongue and pushes it toward the opposite side often interfering with mastication and speech

PATHOGENESIS

The cyst is due to obstruction of the mouth of a salivary duct either from the lingual glands or from the submaxillary glands

TREATMENT

The entire cyst wall must be excised or marsupialized sufficiently that the edges will not re-unite. Because sometimes the wall is thin and friable, complete dissection is often difficult Large ranulas of the submaxillary duct are treated by marsupialization The mucous membrane and top of the cyst are excised down to the level of the rest of the floor of the mouth permitting the lower part of the cyst to become the lining of the floor of the mouth. This method was first given to us by the late Dean Lewis. Bailey (1931) is quoted by Thoma as advising the same type of treatment. He adds that suturing of the margin of the cyst floor to mucosa prevents closing over of the edges and re-formation of the ranula.

Ward (1925) described the technic of cure of ranula by opening and evacuating the cyst and electrodesiccating the lining Any treatment of a large ranula of the submaxillary duct usually results in the opening of the duct being far back in the mouth as the anterior portion is usually destroyed or partly cut away during the treatment

SALIVARY TISSUE TUMORS

Salivary tissue tumors are frequently found in the mucous membrane of the mouth Their occurrence here may be explained by one of two theories. The Cohnheim theory of embryonic rests implies that during the state of embryological development bits of epithelium *destined to form salivary gland tissue* remain in the mucous membrane of the mouth (see Chapter II on Embryology) Another theory is based on metaplasia Since the epithelium of *the salivary glands* comes from the primitive oral epithelium it is not surprising that by a process of metaplasia the squamous epithelium may take on one of its recessive characteristics, salivary gland development, giving rise to a tumor of salivary gland tissue (see Chapter XI on salivary tissue tumors)

Since considerable space has been given to the discussion of aberrant salivary tissue tumors in the mouth in Chapter XI, the reader is referred to that chapter for a comprehensive review

BENIGN MESODERMAL TUMORS

Benign fibromas, lipomas, and myomas occasionally seen in the oral cavity are grouped together since they have common origin in mesoderm An elaborate discussion of the histogenesis of these tumors will not be given

Fibroma

Fibromas, in our experience are not common True fibromas must be differentiated from fibrous granulomas (mentioned above) occurring on the gingiva mucous membrane hypertrophy initiated by trauma and osteomas on the jaws.

PATHOGENESIS

These tumors generally arise in the deep layers of the mucosa or from the periosteum of the jaw

CLINICAL BEHAVIOR

Fibromas are well-defined tumors and produce no symptom other than that due to the size of the mass itself They may be pedunculated or sessile (Fig 22, A and B) Fibromas of the jaws have been discussed in the chapter on jaws

A



Fig 22

A. Cross section of gross specimen of hard fibroma growing in the floor of the mouth.
B Photomicrograph Tumor is made up of thick, interlacing bundles of collagen fiber

HISTOLOGY

The so-called *hard fibroma* is much less vascular than the *soft fibroma* being composed of

Treatment is by surgical excision (Fig 232) The prognosis is good. We have not seen any recur





Fig 228

A. Large sessile hard fibroma of the tongue.
B Healed after electrosurgical removal.



Fig. 229 Benign fibroma of the tongue. Notice how the weight has drawn the pedicle out to a very thin stem



Fig 230 Hemangio fibroma in a small child, springing from the left upper gum and adjacent buccal mucosa.

thick interlacing bundles of collagen fiber (Figs. 227 A and B 228 A and B) The soft fibromas (Fig 229) are more vascular and may show evidence of inflammation and myxomatous change (Thoma) Figure 230 illustrates a hemangio-fibroma springing from upper left gum and adjacent buccal mucosa

LIPOMA

Lipomas may occur wherever fatty tissue is found in the mouth They are slow-growing and benign

PATHOGENESIS

The tumors arise from the fat cells in the gingiva or submucous tissue of the mouth

CLINICAL BEHAVIOR

Clinical findings are similar to those of fibroma, except the tumor is usually softer (Fig 231) It may be pedunculated or sessile and rarely gives symptoms other than those due to the mass of the tumor itself *Geschickter* (1934) found only three lipomas in the oral cavity in a series of 622 lipoid tumors recorded in the files of the surgical pathological laboratory of the Johns Hopkins Hospital, 460 were of the benign solitary type

HISTOLOGY

The tumor is made up of adult fat cells The presence of embryonic cells indicates a more rapid growth (Thoma)

TREATMENT

Treatment is excision They are benign and the outlook is good

TUMORS OF MUSCLE

Muscle tissue tumors rarely occur in the mouth and may be either rhabdomyomas or leiomyomas.

HISTOPATHOLOGY

It is thought by some pathologists that rhabdomyomas are formed from mesenchymal cells destined to develop striated muscle whereas, leiomyomas on the other hand, come from mesenchymal cells destined to form smooth muscles. Willis (1948) suggests that "most rhabdomyomas are embryonic growths arising from immature myoblastic tissue and not from already matured striated muscle fibers. In support of this suggestion he cites the age incidence, structure, and site of origin.

Rhabdomyoma consists of bundles of striated muscle fibers the striations vary in clarity from cell to cell. Leiomyoma is made up of bundles of smooth muscle fibers In both tumors connective tissue and blood vessels are intermingled with the muscle cells.

The term "myoblastoma" has come into usage within the past two decades to describe a tumorous growth composed of round and elongated cells which may or may not be striated in ribbons or bundles. These tumors are not encapsulated the altered cells being distributed irregularly among the adult striated muscle cells of the tongue.

Willis (1948) believes "these lesions to be the result of injury to muscle fibers with subsequent degenerative or regenerative changes. Large granular masses of sarcoplasm in visible continuity with residual muscle fibers strongly suggest regeneration sprouts comparable with those observed by Le Gros Clark in crushed muscle." Present in these tumors are large round and oval cells often granular and in many elongated cells the transition of these granules into striations is seen a picture frequently observed following trauma.



Fig 231 Lipoma arising on the right buccal surface.

This theory seems logical to us as the most common location of these lesions in the oral cavity is along the lateral border or on the dorsum of the tongue. Willis states that the tongue is the most common site in the body for these tumors.

According to Berthrong (1949), who studied the cases in the Johns Hopkins Hospital and also Willis, the overlying squamous epithelium is extremely hyperplastic, almost to the point of confusion with early carcinoma.

"Myoblastomas" are benign One of our cases was recurrent following operation elsewhere one year previously Boyd (1947) after drawing attention to the fact that myoblastomas are made up of round or elongated cells in ribbons or bundles and rhabdomyomas show

striated muscle fibers (more differentiation) states that in spite of this differentiation the a rhabdomyoma Berthrong reviewed nine cases in files of the surgical pathological labora



Fig 232

A. Scalpel excision of small benign growth. The black silk sutures are placed deeply in the tongue before excision of the tumor to control bleeding and facilitate quick closure

B The sutures are drawn tightly and tied securing hemostasis.

C Electrosurgical excision of a small benign growth A small blade electrode is passed around the lesion controlling the bleeding. (Reproduced from The Cyclopedia of Medicine Surgery & Specialties by permission of F A. Davis Co)

tumor (rhabdomyoma) is more malignant than the myoblastoma.

tory of the Johns Hopkins Hospital All were in females varying in age from twenty-six to sixty two years (the age was not given in one case) Four tumors were in the tongue one in the breast three in the subcutaneous tissue and the site in one case was not given The

CLINICAL BEHAVIOR

Tumors of muscle rarely occur in the tongue Those observed have been myoblastomas and

duration of the tumor varied from two weeks to four years before the first surgical excision One patient had a recurrent tumor of the tongue one year after surgical removal in a distant hospital This young woman (one of our private patients) brought the preserved specimen with her Histologically it was similar to the recurrence. All of the tumors in the tongue were located along the lateral borders where trauma is frequent

Examination reveals a rounded submucous, firm circumscribed nodule, 1–2 cm in diameter, which shells out easily through an incision in the overlying mucosa. The one recurrent tumor was not so well circumscribed but adherent in the operative scar A wide area of surrounding mucous membrane and muscle was removed at the second operation

TREATMENT

Treatment is wide surgical excision to prevent recurrence.

Neurogenic Tumors

Neurogenic tumors of the mouth are exceedingly rare. They are formed from nerve tissue. Thoma has reported three cases (1) a neurogenic fibroma (2) a peripheral neuroma, and (3) an amputation neuroma associated with ganglioma We have seen only one case This was a child operated on by Mark Ravitch at the Johns Hopkins Hospital It was a neurofibroma of large size and extended from the floor of the mouth down into the neck and was removed by a 'pull through operation The neck dissection was done first and the wound and the skin flaps closed without disconnecting the tumor from the floor of the mouth. Then the mouth was opened and the tumor dissected above and removed in one mass by pulling it up through the neck The features of neurogenic fibromas in the mouth are similar to neurogenic fibroma elsewhere and are treated by surgical removal.

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Chapter VIII

MALIGNANT TUMORS OF THE ORAL CAVITY

This chapter includes a discussion of the diagnosis and treatment of malignant lesions involving the gingiva buccal mucous membrane hard and soft palate Malignancy of the tongue and floor of the mouth will be discussed in Chapter IX and malignancies of the tonsils and pharynx in Chapter XII Since the jaws are invaded frequently by malignancy in the mouth it will be necessary to describe treatment of the jaws when so invaded but this chapter will not include a discussion of primary tumors in the jaws or antrum (see Chapters X and XIII)

The grouping of cases in this chapter is largely on a diagnostic and therapeutic basis The differential diagnosis of malignant tumors in the mouth lies between similar groups of neoplasms frequent on the upper gingiva, hard and soft palate for example salivary gland tumors both benign and malignant are more common in these locations than on the buccal surface or on the gingiva of the lower jaw In the latter locations the differential diagnosis is between other similar growths

Treatment of tumors of the upper gingiva and palate present similar problems as involvement and erosion of the antrum may result in each Carcinoma of the buccal mucosa and lower gingiva likewise have similarities.

INCIDENCE

The reports of the Bureau of Vital Statistics of the United States for 1944 show that 2950 males and 701 females died from cancer of the buccal cavity Out of this group 547 males and 171 females died from "cancer of the mouth Cancers of the lip tongue and jaw bone and unspecified parts of the buccal cavity were included in the larger figure of cancer of the buccal cavity One would suppose then that cancer of the mouth means other areas such as the inside of the cheeks gingiva palate etc According to Martin (1942), the admission records of the Memorial Hospital in New York show that 'malignant tumors of the palate including benign mixed tumors, make up about 8 per cent of all oral cancer and about 5 per cent of all cancer of the upper respiratory and alimentary tract and about 2 per cent of all human cancer Martin also states that the relation of malignant growths to benign mixed tumors in the palate is 12-1

ETIOLOGY

Perhaps the most common etiological factor in the development of cancer of the oral cavity especially on the buccal surface is trauma One must bear in mind however that trauma alone is not the only causative agent for trauma occurs in many patients and only in a certain percentage does cancer develop Ragged sharp teeth are often stimulating agents to cancer of the buccal mucous membrane Malfitting dentures either complete plates or bridges, overlie cancerous ulcers which go on for weeks or months without the patient's knowledge Suddenly local discomfort or discovery by the tongue of a rough area or the accidental finding by a careful observant dentist reveals an extensive growth of long duration Sometimes in the upper and lower gingiva the ulcerated growth has continued through the periosteum into the bone long before the patient is aware of it The relation of leukoplakia to cancer has been discussed in Chapter XII Acute leukoplakia must always be considered a premalignant lesion and treated whereas chronic leukoplakia should be watched at regular intervals by a physician Tobacco is a chemical irritant associated with cancer of the mouth in a high percentage of cases whether used by chewing or smoking In the latter heat is a contrib-

uting factor In some countries, betel nut chewers and buyo chewers (Davis, 1915) are subject to cancer of the buccal surface According to Davis, it is common among the Philippine women to chew buyo which is a combination of buyo leaf black lime and tobacco, and betel nut Syphilis is also frequently co-existent with cancer of the mouth, requiring serological tests. Martin reports that the serological test for syphilis was positive in 15 per cent of their cases of buccal surface carcinoma

Although cancer of the mouth is more common in men than women we have seen a surprising number of women with buccal cancer in both smokers and non smokers.

Adenocarcinoma, squamous carcinoma, and sarcoma, arising in mixed salivary tissue are to be looked upon as having an embryological basis. As has been discussed elsewhere there are two theories accounting for the occurrence of tumors springing from tissue not normally present in the mouth The Cohnheim theory of embryological rests and the theory of metaplasia. The mucous membrane of the mouth which is ectodermal in origin has the potentiality of developing six adult structures squamous cells, mucous glands, tooth buds, salivary tissue thyroid tissue, and Rathke's pouch of the hypophysis (see Chapter II) Whitmore (1938) discusses this interesting phenomenon of metaplasia and quotes Johannes J Orth as also looking upon the occurrence of a tumor originating from a type of tissue outside its normal habitat as due to metaplasia

DIFFERENTIAL DIAGNOSIS

In the majority of cases a differential diagnosis of malignant disease of the oral cavity is not difficult to the trained eye and finger because most of these patients come in at a rather advanced stage this in spite of the intensive educational propaganda of the last thirty years. Delay in seeking proper medical diagnosis and treatment is due to ignorance and fear on the part of the patient as well as to lack of education of the first or second physician and/or dentist who sees the patient. Lack of pain lulls the patient into a sense of security for he feels that the ulcer or tumor is of little significance It is gratifying that in the last fifteen years, since teaching in a dental school and discussing oral cancer problems before dental societies, an increasing number of premalignant and early malignant cases are coming for diagnosis. The three most common chronic ulcers of the mouth to be differentiated from cancer are syphilis tuberculosis, and ulcerated and thickened leukoplakia As discussed in Chapter VII other lesions of unknown etiology, such as psoriasis, lichen planus, and granulomas, most frequently on the gum, but occasionally on the buccal surface, are also to be differentiated The more acute lesions traumatic ulcers Vincent's angina secondary syphilis, aphthus ulcers etc. are usually differentiated by the history of short duration and the painfulness of the lesion Many patients, now cancer-conscious, are coming with a traumatic abrasion of the mucous membrane which has lingered on for several weeks. This is a healthy situation

Although syphilitic and tuberculous ulcers have been described carefully in Chapter VII, they are important enough to bear brief repetition Syphilitic ulcers to be differentiated from cancer are of the tertiary type They are painless dirty, with ragged overhanging edges and usually located in the tongue A hard indurated area or nodule felt with the gloved finger is the site for biopsy Should biopsy be negative for cancer and should the ulcer not respond to anti syphilitic treatment within two or three weeks, further biopsy is imperative

Tuberculous ulcers are described in Chapter VII The most common location is in the tongue, but they do occur on the buccal surface upper and lower gingiva, and palate and anterior pillar of the fauces. A characteristic feature is pain in a clean rather superficial ulcer with a nodular base Tongue ulcers are often deep with elevated or overhanging edges. Ulcers on the palate, gingiva and pillars are shallow because of the underlying bone, the edges are only slightly if at all,

elevated Tuberculous ulcers are always secondary *to pulmonary* tuberculosis.

Leukoplakia has also been discussed in Chapter VII It is *of sufficient interest to* repeat here that leukoplakia must be considered as a premalignant lesion particularly when it is of relatively short duration a few weeks or months and is piled up thickened papillary fissured or ulcerated Such lesions should be carefully palpated and an adequate *biopsy taken from any* indurated nodule or area.

BIOPSY

Adequate biopsy is the only real diagnostic procedure to determine the presence or absence of cancer A positive serological test for syphilis is no excuse to eliminate biopsy for syphilis and cancer are often co-existent In times past patients have come with extensive cancer having been treated for syphilis until the *golden opportunity for cure was lost all be*cause the STS was positive and no biopsy was done to ascertain the presence of the cancer It is necessary that the biopsy be taken from a suitable place in the lesion It may be that the growth itself is small and can be excised *en toto* for microscopic study (buccal mucosa) *Biopsy is necessary as a diag*nostic measure before instituting any therapy The specimen must be taken from a typical area preferably at the edge of the ulcer where the growth encroaches upon the normal tissue This gives the pathologist an opportunity to study invasive characteristics (See Chapter I) *Never take a biopsy from a markedly infected* zone where granulation tissue may so overshadow the growth as to completely hide the presence of malignancy Never take a biopsy from a sloughing area. If the first biopsy is negative and the clinical picture is strongly suggestive of cancer, repeat the biopsy until one is reasonably sure that cancer is not present It may be necessary to excise a palpable *lymph node to obtain tissue free from in*fection for adequate pathological study

MALIGNANT TUMORS

SQUAMOUS CELL CARCINOMA

Squamous cell carcinoma is the most common malignant lesion in the oral cavity (Fig *233 A–D*) It may appear as a painless small or large ulcer infiltrated or elevated with *indurated edges and an indurated base* Usually squamous cancer is a clean ulcer in the early stages. Other times the squamous cancer begins as a condylomatous or papillary growth of greater or lesser size The vegetative and papillomatous growths are not so malignant and do not invade lymphatics to metas*tasize as early as infiltrating types. Infiltrating* carcinomas on the gingiva are frequent more so than on the buccal surface and palate An invasive growth on the buccal surface or gin-

PLATE X

A *Leukoplakia of tongue which has undergone carcinomatous changes on left side*

B Cancer of tongue middle third. Lesion developed six months ago no palpable nodes Treatment radiation intra and extraorally followed in six weeks by hemiglossectomy and radical neck dissection in continuity (composite operation)

C. Cancer of posterior third of tongue in 83-year-old male that has extended onto gingiva Treatment Intra and extraoral radiation

D Cancer of base of tongue in 50-year-old female that has extended onto anterior tonsillar pillar Firm nodes at angle of mandible Treatment Intra and extraoral radiation composite operation See text

E. Leukoplakia buccal mucous membrane in 60-year-old male which disappeared after removal of infected teeth discontinuance of smoking, and radiation therapy (1800 r) Patient developed squamous cell carcinoma in same area six years later

F Leukoplakia, soft and hard palate present four months. Patient did not smoke No oral sepsis STS negative Patient had squamous cell carcinoma in floor of each nostril one year previously Eradicated with 6000 r to each side. Successful treatment of leukoplakia with 100,000 units Vitamin A, daily for one month but vitamin therapy continued for three months



A



B



C



D



E



F

jaws and sinuses be carefully studied to determine *the limits of the disease before treatment* is begun

Adenocarcinoma

Adenocarcinoma develops from embryonic epithelium destined to form mucous or salivary glands and therefore they usually begin deep in the structures or beneath the mucous membrane and ulcerate late (Fig 234 A–C) Onset may be with or without pain Pain is at times associated with the deep bone involvement before the growth ulcerates through the mucous membrane surface Many times the first symptom is the loosening of teeth The patient seeks the attention of a dentist the teeth are extracted with or without previous x ray studies, and the patient is inclined to blame the subsequent course of the disease on the extraction of the teeth when, in reality the tumor loosened the teeth before they were extracted. Since these tumors invade the underlying bone early in the course of the disease careful roentgenographic studies are essential to proper diagnosis and as a guide to treatment

Roentgenographs show malignant invasion of bone characterized by irregular motheaten honeycombed radiolucent shadows, with no periosteal reaction or new bone formation as in *osteomyelitis* It is difficult however at times to distinguish these tumors from osteomyelitis. Osteomyelitis attacks chiefly the organic bone structures the haversian canal system and only to a lesser degree the calcium salt resulting often in the formation of sequestra. Malignancy on the other hand causes destruction of inorganic and organic structures, and leaves large or small radiolucent areas. For further description of differential diagnosis of benign and malignant bone involvement and osteomyelitis see Chapters X and XX

Malignant Tumors of Salivary Tissue Origin

What has been said about adenocarcinoma so far as symptomatology is concerned also applies to *mixed salivary tissue tumors when* malignant The benign variety are discussed at length in Chapter XI Suffice it to say here that every patient who has had a mixed tumor of salivary tissue removed from the oral cavity should be watched carefully for possible recurrence We have had two interesting patients who illustrate late recurrences. One was an elderly white woman who had a mixed tumor of salivary tissue removed from the left tonsil Ten years later she came into the clinic with a hard mass in the left submaxillary salivary gland region Microscopic examination of this second tumor showed it to be exactly like the first and apparently a metastasis from the first tumor after ten years.

The second was in a white girl aged 15 who came to the dispensary with an ulcerated lesion at the junction of the soft and hard

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Plate VI

A. Squamous cell carcinoma, buccal mucosa. Can be treated either with radiation 7000 r using a cone, or surgical excision with a wide margin. See Chapt. VIII.

B Squamous cell carcinoma beginning on mucous membrane of right cheek and extending to commissure of lip. Can be treated with radiation 6500 r or surgical excision allowing wide margin

C. Squamous cell carcinoma of hard palate extending from alveolar ridge almost to midline Treatment Extraction of teeth from involved area, intraoral x-ray therapy 6000 r followed in six weeks by electrosurgical excision of superior maxilla and radical neck dissection, when lymph nodes are palpable Prosthesis fitted after surgical excision.

D Squamous cell carcinoma, alveolar ridge, extending onto hard palate. Treatment Intra and extraoral radiation. Prognosis poor on account of widespread growth.

E. Malignant melanoma of alveolar ridge of eight months' duration. Treatment Extensive resection of alveolar ridge. Patient died from metastases.

F Squamous cell carcinoma beginning in area of leukoplakia of buccal mucosa. Treatment Intraoral radiation 8000 r using a cone, giving a wide margin.

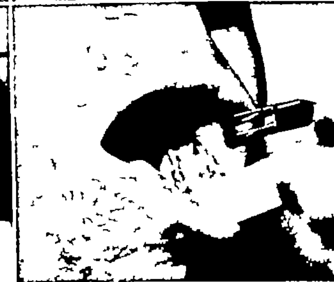
A

B

C

D

E

F


Lymphosarcoma and leukemias are radiosensitive A discussion of their treatment is given in Chapter XVIII

SURGERY AND ELECTROSURGERY

Since the surgical approaches and preoperative and postoperative technic are the same for the removal of any type of malignant tumor of the mouth irrespective of its histological picture, all types of tumors to be removed surgically are dealt with under this



Fig 236. Malignant melanoma involving the upper gum nasal mucosa, and extending into the antrum. Exact site of origin could not be determined.

heading Surgery of neoplasms about the oral cavity present several difficult problems The technical approach is one which must be accompanied by a thorough knowledge of the anatomy and physiology of the parts. The structures about the mouth are closely placed together so that the removal of adequate tissue for cure of cancer usually leaves disfigurement and dysfunction The careful application of fundamental surgical principles, and especially the rules of plastic surgery are necessary for success without jeopardizing the patient s chances for cure Immediate plastic repair is carried out when feasible in order to rehabilitate the patient with minimum time loss Extensive carcinomas about the mouth often require such destructive operations that the assurance of complete eradication at the first operation is questionable and the application of a previously prepared skin flap might so conceal the operative area that recurrences are not observed until beyond probable cure In such cases it is better to leave the wound wide open so the operative field may be watched for several months before plastic repair is attempted It is granted of course that this puts the patient through a long period of discomfort and convalescence but in many of our cases we have found this worthwhile (Fig 237 A-E)

The principles of removing a wide margin of tissue on all sides of the growth, however cannot be followed at all times while operating for tumors of the mouth Where it is impossible to resect completely a given area of cancer the residual tumor is destroyed with a strong coagulating current (see Chapt I) and allowed to slough. Healing takes place by granulation and cicatrization. Cancers that have invaded the maxilla and extended into the pterygoid fossa, nose or orbit require this method of surgical attack.

In spite of ever present infection surgical wounds about the mouth heal remarkably well and often by first intention. However cancerous wounds, often harbingers of virulent organisms, not uncommonly break down postoperatively Present-day antibiotics such as penicillin sulfa drugs and streptomycin reduce postoperative wound contamination to a minimum which nature controls Seldom is postoperative sepsis a problem nowadays

For a discussion of details of surgical care, the reader is referred to Chapter I

Hemorrhage The tissues about the mouth are vascular and their tributary vessels large The control of hemorrhage must always be planned for prior to the operation Ligation and section of the external carotid artery and its

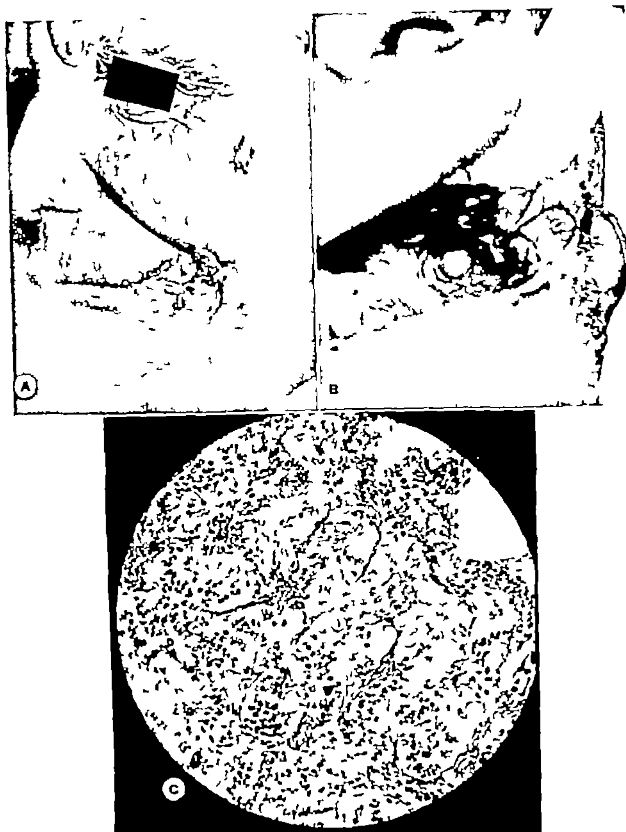


Fig 237

A and B Carcinoma of the buccal mucous membrane which has grown through the cheek and presented externally

C Photomicrograph showing anaplastic radiosensitive squamous cell carcinoma. Marked improvement after radiation therapy tumor greatly reduced in size and became operable

branches on the same side as the lesion frequently reduces operative bleeding and postoperative hemorrhage Occasionally when the growth is large and extends to the midline ligation of both external carotid arteries is necessary This is more apt to be the case with carcinomas of the tongue and floor of the mouth than other oral cancers. Ligation of both external carotid arteries when required is better spaced at a week or ten day intervals to prevent sloughing of the tip of the tongue an unwelcome complication occurring in a few of our cases.

in case a large vessel is opened and the tissue retracts out of reach Constant tension on the sutures keeps the tissues far back in the mouth under control at all times These silk stay sutures occupy much less room than instruments.

Bleeding should be controlled immediately after a vessel is opened that is the incision should be made for a short distance and then hemostasis secured before it is extended further Electrosurgery is a great asset in keeping the wound dry Small blood vessels and capillaries are controlled by an electrosurgical

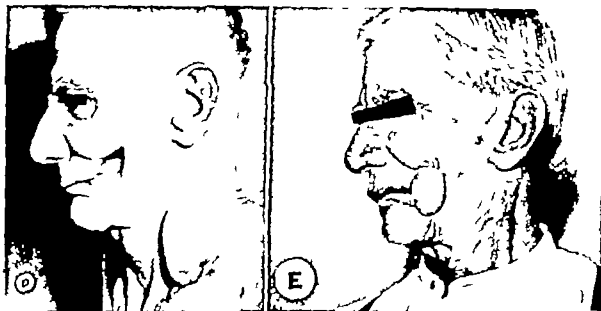


Fig. 237 D–E

D and E. The involved and scarred area of the cheek was removed with electrosurgery and a long tubular flap was inserted several months later after assurance of non-recurrence. As time went on, this rather thick flap thinned out to give a good cosmetic result

Equally important, the operator must anticipate bleeding points and keep the operative field under control and dry at all times eliminating embarrassing loss of blood at times difficult to control with hemostats in such a narrow field as the mouth Extraoral approaches, permit easier control of hemorrhage because of the larger amount of working space We have found it of great advantage to outline the anticipated line of incision by two rows of stay sutures of black silk The incision is then made between these two rows. The sutures on the growth s side serve for traction purposes, while those on the side away from the incision serve for traction purposes but are safeguards

cutting current (Electrotomy Chapt I) larger vessels are touched with the ball-tipped coagulator the pressure closing the vessel. The current is then turned on with a foot switch sealing the bleeder The applicator should not be applied while the current is running for there will be charring of the flowing blood making a messy wound and destroying more normal tissue than necessary Ofttimes a large oozing surface is left which can be dried by firm pressure with a gauze sponge As the sponge is moved across the raw surface it is followed by the ball coagulator closing bleeding vessels as they appear from beneath the sponge

Cancer of the Gingiva and Hard Palate

Down through the years, the treatment of cancer of the gingiva and underlying bone has varied from surgery to radiation or a combination of both. There is a tendency now to rely upon radiation for the destruction of the primary growth and to resect the neck lymph nodes if palpable. Since heavy radiation is necessary to eradicate squamous cell cancer of the mouth, complications of secondary radiation necrosis of the soft parts and bone often require surgical removal at a later date. This being the case and since recurrence is frequent after radiation, we have adopted the policy of a combined course of treatment: radiating the primary lesion first and, in from four to six weeks, removing it electrosurgically. We rarely irradiate pre- or postoperatively adenocarcinoma and carcinomas arising in mixed salivary tissue.

Malignancies of the upper gingiva and maxilla rarely are small enough when coming for treatment to permit of local electrosurgical resection intraorally. There are some exceptions and when the growth is under 2.5–3 cm in diameter and has been thoroughly irradiated it is excised through the mouth (Fig. 238 A–D). Electrotomy (electrosurgical cutting) or the actual cautery is essential for this procedure. An incision is made with the

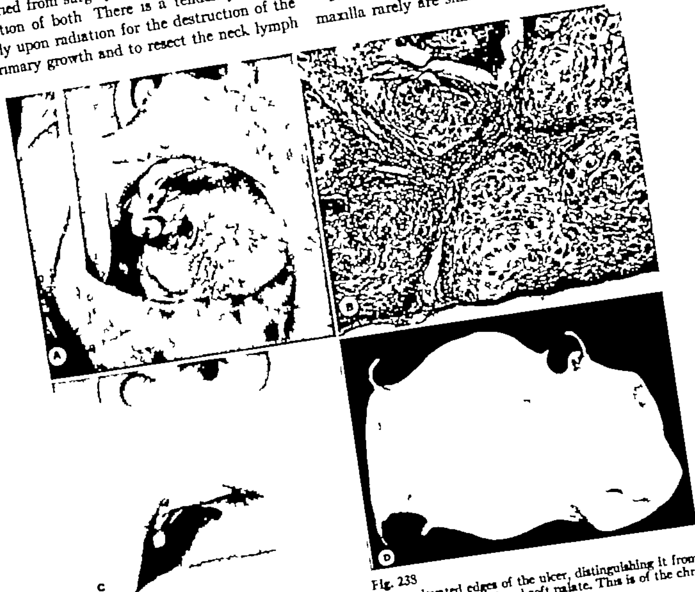


Fig. 238

A Squamous cell carcinoma, right upper alveolus. Note elevated edges of the ulcer, distinguishing it from an inflammatory process. Also notice the leukoplakia extending over the hard and soft palate. This is of the chronic type with craters in the center of which are tufts of capillaries, causing bleeding in some cases.
B Highly differentiated squamous cell carcinoma, the type that arises in leukoplakia.
C Defect in superior maxilla following irradiation and electrosurgical removal.
D Prosthesis with obturator filling the upper surface of the defect, allowing normal eating and talking.

electrotome around the growth at a safe margin of a centimeter or more through the soft tissue The bone is then removed with mallet and chisel. Usually this operation opens into the antrum which is then carefully explored If it is found that the growth has extended up into the nose or antral walls, it is patients have been rehabilitated by such prosthetic appliances (see Chapt XXI)

Since most cancers of the upper gingiva come late and since they invade the bone early we have come to the conclusion that, if there is any roentgenological evidence of invasion of the maxilla, and especially the



Fig 239 Squamous cell carcinoma of the hard palate which has invaded the superior maxilla and antrum. Note destruction of the left alveolar process of the maxilla (no 1) and inferior (no. 2) and lateral wall of the antrum. There is also invasion through the hard palate into the left nasal passage (3)

followed with electrosurgery as far as possible. Healing is by granulation and cicatrization

During the convalescence, the mouth is irrigated with suitable antiseptics or normal salt solution Immediately postoperatively the wound is packed with iodoform gauze If the antrum has been opened, the patient should wear a temporary denture post operatively This denture is replaced by a permanent one after the wound has entirely healed Many antrum the extraoral approach is indicated The operator is frequently surprised to find growth extending well up in the bone either along the lateral antral or nasoantral wall to a much greater extent than was demonstrable clinically or by roentgenological examination (Fig 239)

The extraoral approach by way of a Fergusson incision as for removal of the superior maxilla for carcinoma of the antrum is

illustrated in Chapter XIII. The skin incision is made with a scalpel beginning in the middle of the upper lip it passes upward to just beneath the columella of the nose thence around the ala on the affected side and up along the border of the nose to one and one half cm. below the inner canthus of the eye. The incision may stop here temporarily provided the clinical and roentgenological preoperative investigation has shown little evidence that the upper antrum is involved. The incision extends through the skin and mucous membrane of the lip and down to the bone for the rest of its course As the cheek is dissected off the maxilla, an incision is made in the mucous membrane of the vault of the gingivo-buccal sulcus and carried back to the alveolar tuberosity Later in the operation if the growth is found to have extended high into the antrum or out into the malar bone, the horizontal limb of the Fergusson incision is made, extending from the vertical limb near the inner canthus of the eye in a convex line with the convexity downward along the lower border of the orbit out to the *zygomatic* arch or the ear if indicated (see Fig 369, Chapt. XIII) With the electrotome, an incision is then carried through the mucosa of the midline of the palate at a safe distance from the growth and then laterally behind the tumor to the cheek The midline of the upper jaw is cut through with hammer and chisel. Any other bony attachments are likewise severed with hammer and chisel or bone cutters and the entire area of involved jaw removed Rarely is it necessary to remove the entire superior maxilla for cancer of the upper gingiva as in cancer of the antrum. If the naso-antral wall and the orbital plate are not involved they are left untouched giving better cosmetic and functional results. At times it is necessary to carry the mucous membrane incision back into the soft palate, then laterally behind the superior alveolar tuberosity

Unresectable areas of growth are thoroughly destroyed with electrocoagulation and radium applied immediately at the operating table or the locations of inoperable sites are carefully noted and radiation given locally later either by direct application of a radium plaque or implantation of radon seeds depending upon the situation Figures D, E, and F, Color Plate IX illustrate the result after resection of carcinoma of the upper alveolus through a Fergusson incision

Malignant tumors occasionally occur on the hard palate just back of the central incisor teeth, an area difficult to radiate with x ray even through an intraoral cone inserted after extraction of the anterior teeth Radiation may be given to this area by means of the leaded resinous applicator devised by James Edward Pyott and described by Pyott, et al in 1942 (see Fig 244) Such applicators carefully protect the normal tissue of the tongue and floor of the mouth as the radiation chamber is surrounded with lead except for the face against the tumor The application may be repeated accurately at desired intervals Cancers in the anterior portion of the palate are greatly reduced by preoperative irradiation but the proximity to the bone usually means radio-osteonecrosis will follow For this reason and because all tumors are not destroyed by irradiation, it is necessary to remove electrosurgically the anterior portion of the palate, either on one or both sides The anterior alveolar process is resected back behind the growth After healing the patient is rehabilitated by a well fitting prosthesis (see Chapter XXI)

Small cancers of the lower gingiva under 2 cm in diameter may be treated by intraoral radiation with x ray through an intraoral cone or Pyott applicator carrying radium. In four to six weeks electrosurgical removal with a wide margin is carried out through the mouth

Unfortunately patients with cancer of the lower gingiva and mandible seldom come in the early stages when intraoral resection is possible. Cancer of the gingiva also frequently extends onto the buccal surface or downward into the floor of the mouth rapidly requiring radical operative procedures taking in the adjacent soft tissues. An extraoral approach is preferable Here again we advise irradiation four to six weeks preoperative

A composite operation has been devised and described by Ward and Robben (*in press*) The details of this operation are given in Chapter XIX. Since cancer of the gingiva and jaw metastasizes early, it has been our policy in recent years to carry out a routine neck dissection and removal of the primary growth including the jaw and part of the floor of the mouth *en bloc*

For pre and postoperative surgical care and complications the reader is referred to Chapter I

Carcinoma of the Soft Palate

Cancer and malignant tumors of the soft palate are rare (Fig 240 A B and C) Most of these are squamous cell carcinomas and in our experience have been sensitive to radiation (see below) Rarely is surgical removal indicated Figure 241, A B, and C illustrates the removal of a sarcoma of the soft palate from the mouth of a boy whose history is given on page 251 Radical removal of the soft palate was indicated because of the number of recurrences of the sarcoma and its demonstrated radioresistance. The patient was rehabilitated with a prosthetic appliance made by James E. Pyott which extends back across the lower portion of the nasopharynx, aiding in talking and preventing food getting up into the nasopharynx or nose

The patient was anesthetized with sodium pentothal and an intratracheal tube inserted through which nitrous-oxide and oxygen were given while the pentothal was continued A row of black silk stay sutures were inserted at a distance from the tumor for traction, lifting the tumor out as it was excised with an electrotome. The operative wound was then thoroughly sterilized with a ball coagulator In Figure 241 B the coagulator is shown closing a small vessel in the tumor which gave annoying bleeding Constant aspiration of mucous and blood was maintained by an assistant

Carcinoma of the Buccal Mucosa

The treatment of carcinoma of the buccal surface has swung from radical surgical excision over to radiation We now feel that the small and moderate-sized buccal lesions give the best results by radiation (see p. 263) Occasionally persistent or recurrent lesions are removed electrosurgically more extensive ones require resection of the entire cheek followed immediately or at a later date by plastic repair (Fig 238 A–D) Carcinoma occurring far back on the buccal surface near the angles of the jaws gives a persistently poor prognosis, either by radiation or by extensive surgical removal. Early and extensive invasion of the surrounding soft parts and maxilla practically precludes surgical procedures Polya (1926) has described a great variety of unique operations for removing small and large cancers of the buccal mucosa and immediate closure by plastic flaps Skin flaps reconstruct the mucous membrane, and other skin flaps close the skin and cover the flaps used to reconstruct the mucous membrane. Since ir radiation has given such good results in the treatment of the local disease, we have not employed these extensive operative procedures. In some of Polya's operations he removed the submaxillary lymph nodes when the skin of the neck was opened for the construction of the flaps in others he removed the jaw and lower gingiva together with submaxillary lymph nodes in one mass. The fat of the retromandibular region is taken out and the resulting cavity cauterized with a cautery or electrosurgery Polya does not line the skin flap of the face and upper neck as described in our procedure in Chapter XIX

Occasionally it is possible to save the inner or lingual side of the mandible when the buccal carcinoma has involved the soft tissues and gingiva only on the lateral side of the bone Polya has described such a procedure which is similar to one we have used for many years and developed independently After resecting the soft parts by whatever method is indicated the growth is stripped away from the mandible When the periosteum peels away the hard cortical bone is removed down to cancellous bone for better healing Bone in

vaded by the growth requires deeper coagulation, rongeuring away and coagulation This alternation of coagulation and rongeuring away cheek and upper neck serves to close the wound When the growth has destroyed the bulk of the soft tissues of the cheeks and at

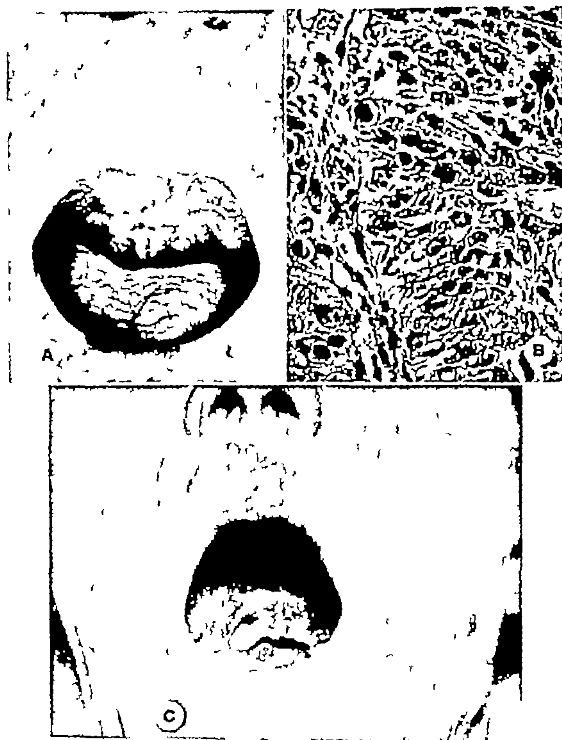


Fig. 240

A Squamous cell carcinoma of the soft palate involving the uvula.
B Photomicrograph showing anaplastic type of carcinoma sensitive to irradiation.
C Photograph showing the palate and uvula healed after irradiation.

is carried down to good healthy bone The inner table of the mandible is allowed to remain limiting disfigurement Uninvolved skin of the tached itself to the skin the skin must be sacrificed leaving a defect Sometimes this defect may be closed by plastic procedures im-

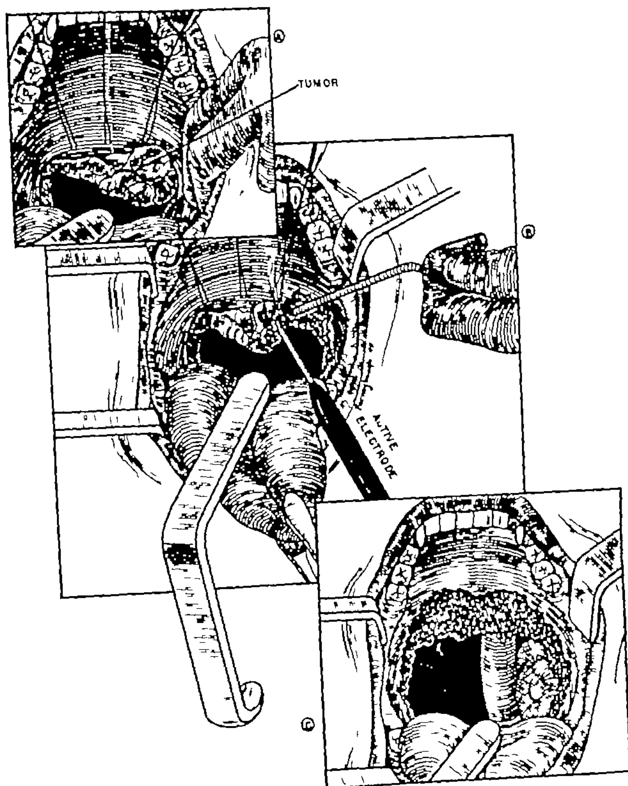


Fig. 241

ABC Technic of electrosurgical removal of sarcoma of the soft palate History given on page 251 Patient had been operated on eight times and had received a great deal of irradiation

A. Dotted line shows incision anterior to the junction of the hard and soft palate Notice black silk stay sutures for making traction on the normal tissues at the edge of the growth

B Electrotome coagulating a bleeding point in the tumor Aspirator constantly in the field to take away smoke and blood

C. Wound remaining after electrosurgical removal of tumor thoroughly coagulated leaving a sterile dry surface Note intranasal intratracheal tube for inhalation anesthesia.

mediately, and, at other times, the wound must be left to heal and closed secondarily

Blair et al. (1935) and Kelly and Ward (1932) have described a method of electrosurgically sterilizing the involved mandible after resecting the soft tissues away on all sides The mandible is sterilized by application of the ball coagulator to all points so that the bone is heated through The bone is allowed to remain in position until it sequestrates During this time the soft tissues heal down around the bone the sequestrum left in place prevents the opposite mandible and chin from drifting to the operative side As the sequestrum loosens it is lifted out. Following a reasonable length of time (six months to a year) to assure against recurrences, the defect is closed by suitable plastic procedures. This method of maintenance of the normal unoperated jaw is now replaced by prosthetic appliances (see Chapt XXI) The prosthesis is prepared ahead of time and inserted either just prior to or during the operation A properly fitting guide plane for the normal side is fastened on the lower prosthesis and rides over a bar fixed to the upper teeth Edentulous patients present a more difficult problem The normal side may be held in place by Haines pins in the malar bone and mandible, connected by an outside extraoral bar The pins remain for four to six weeks until assurance that further healing of the operated side will not cause traction and shifting of the jaw (see Fig 242 A–E)

Radiation Therapy

Radiation therapy in the treatment of squamous cell carcinoma of the buccal mucosa, gingiva and soft palate occupies an important place Many of these primary tumors are completely eradicated by irradiation (Fig 243 A–D) Often this is the only treatment of the local growth needed. Cancers on the hard palate and upper and lower gingiva are treated with radiation preoperatively Operation is performed following the radiation for two reasons (1) to assure complete removal of the cancer and (2) to obviate the complications of radionecrosis of the soft parts and bone Heavy radiation necessary to eradicate squamous cell carcinoma overlying bone in these cases is bound to destroy the periosteum and give rise to radio-osteonecrosis in a large number of cases. These complications cause pain and ulceration and are always secondarily infected It is difficult to determine without biopsy whether this is a true regrowth or radionecrosis Electrosurgical removal within four to six weeks after the completion of the radiation, obviates the painful sloughing period that so frequently occurs.

With modern roentgenological technic, tumor doses of 6000–7000 r are delivered to most



Fig. 241 D
D Photomicrograph of sarcoma

of the growths in the mouth through a suitable-sized intraoral x ray cone. Cones can usually be accurately focused on the soft palate on either buccal mucosa and on the upper and lower gingiva. In the latter locations, it is necessary to remove the teeth before radiation is begun or during the first week of the course of treatment Sometimes it is necessary to remove the teeth on upper or lower jaw in order to adequately treat the buccal surfaces. The teeth should always be removed from any area of the jaws to be radiated, both for ready access to the area and because of the likelihood of secondary complications Although the soft tissues may heal around the teeth the surrounding bone and periosteum is devitalized and

the scar is a fertile field for secondary infection Several months or years afterwards if the teeth become infected and require removal radio-osteonecrosis is bound to occur We have observed this complication in patients from a few months to ten years (see Fig 242) after radiation In the illustrated case, radio-osteonecrosis followed dental infection ten years after the radiation of a basal cell epithelioma of the right cheek.

Our technic for such intraoral radiation with x ray is as follows The factors are 140 Kv 15 Ma no filter T.S D 35 cm. 300–500 r are given at each sitting three times a week and carried up to 6000–7000 r

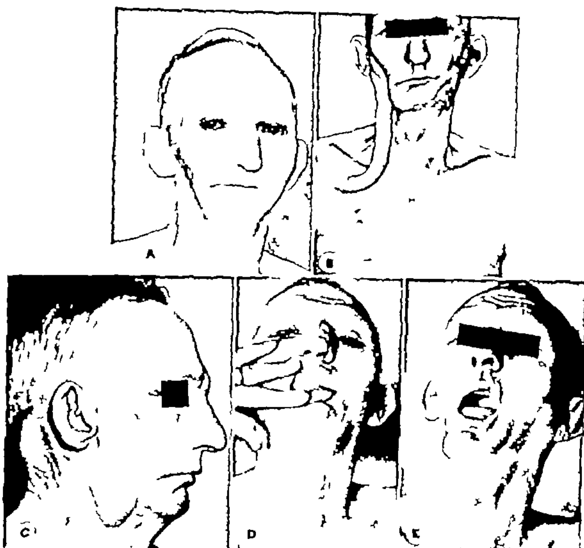


Fig 242. Patient had basal cell carcinoma of the cheek treated with radiation 13 years previously Three years ago radio-osteonecrosis of the mandible developed following extraction of infected teeth. Result loss of mandible from the lower premolar region up to and including the condyle.

A Scarred soft tissues pulling mandible to right out of alignment. Patient was completely edentulous.

B Long tubular flap with pancake expansion on distal end, constructed on the chest wall transferred to cheek. The scarred skin and soft parts of the cheek were resected. Fortunately there was sufficient mucous membrane to line the cheek without tension on the mandible. Haines pins and splints in place in left maxilla and mandible.

C. Graft well taken, the edematous lower portion needs to be corrected

D Although this patient was completely edentulous, K. L. Johnson, D.D.S., of Raleigh, N C. made upper and lower dentures, providing perfect mastication. Patient states he can eat nuts and beefsteak.

E. Mouth open showing that motion of the mandible does not allow drifting to the operative side

Radium applications are serviceable particularly in certain areas not accessible to the x ray cone such as the anterior portion of the hard palate behind the teeth even though these teeth are removed it is often hard to

give an accurate adequate dose along the curvature of the palate Carcinomas far back on lower or upper gingiva or buccal mucosa may be treated by these specially prepared applicators Also patients having varying degrees pound is molded to the part to be irradiated, taking in a sufficient amount of surrounding structures so that the applicator may be held accurately in position. On the surface over the growth warmed radium needles or tubes are



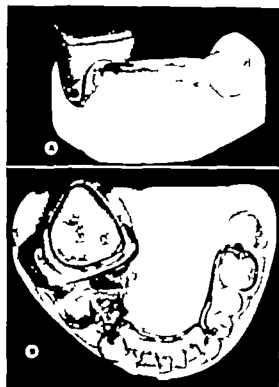
Fig 243

A. Elderly white man with extensive squamous cell carcinoma of the right buccal mucosa.
B Radiation epithelitis of the skin. Similar reaction develops on the mucous membrane in the region of the tumor
C Thin, atrophic skin, following healing of the epithelitis.
D Mucous membrane healed from radiation therapy alone

of trismus cannot open their mouths sufficiently to allow the insertion of a cone

For purposes of intraoral radiation with radium Paterson Melville, Ackerman, Pyott, et al. and others have devised various forms of applicators made out of different materials. A handy material is the ordinary dental compound When softened in hot water this compartially buried, normal structures surrounding the area are kept at a distance by the thickness of the mold or by the application of layers of lead on the side of the mold opposite the radium. Pyott's applicator is made of acrylic and accurately fits the part to be treated (Fig 244 A–E) It is made sufficiently large and of the proper shape to fit over the adjacent teeth

or extend to teeth on the opposite side of the jaw More elaborate applicators are made with a cast bar and clasps attached to the acrylic base A protective lead chamber with a suitable lead lid is constructed over the area to be treated Into the chamber radium tubes are placed in proper position and the lid sealed on with dental wax The advantage of this particular mold is that radium can be taken out and the applicator saved for subsequent treatments. In this way a series of applications are given at specified intervals, each succeeding treatment exactly placed over the growth In this manner the broken dose method of Coutard is simulated We usually follow Quimby s Table in calculating dosag giving up to 7 000 gamma roentgens over t lesion unless it has previously had x radiatic Our aim in combining the two types x ray a gamma radiation, is to reach a tumor dose 7 000 gamma roentgens if possible



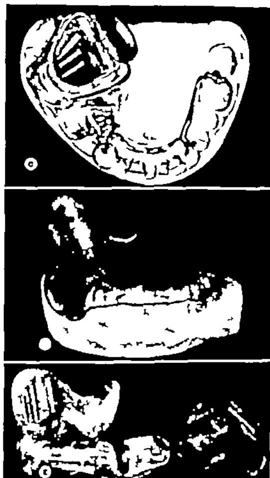


Fig. 244. Pyott's leaded resinous applicator for intraoral radium therapy

A, B and C. Applicator for treating carcinoma of lower right molar area. In "C" the lead cover has been raised to show radium element tubes. This applicator is held in place by clasps on normal teeth.

D and E. Applicator for treatment of carcinoma far back on right buccal surface and adjacent palate In "E" lead cover is removed to show radium tubes in place one tube has adhered to the cover This applicator is made entirely of acrylic much less expensive to make. It may be used over teeth as pictured or in the edentulous mouth. (Courtesy Amer Jour Roent. and Rad. Therapy)

Cancers involving the soft tissues are often thick involving the depth of the cheek or extending back into the pterygoid fossa or masseter muscle and are occasionally treated by the implantation of radon seeds or radium element needles. Such implantation is not as frequently employed in cancer of the buccal mucosa, gingiva and palate as in the tongue and floor of the mouth

METASTASES OF CANCER OF THE BUCCAL MUCOSA GINGIVA, AND PALATE

To anticipate the occurrence of metastases to the surrounding lymph nodes, one must understand the lymphatic drainage from the oral cavity As will be noted in Figure 11, Chapter I, the lymphatics from the posterior portions of the cheeks drain into the parotid nodes those from the anterior portion drain into the submaxillary nodes. The deep lymphatics of the cheek drain into the facial nodes. The lymphatics from the lower gums unite into several stems which pass over the outer surface of the mandible opposite the last molar tooth to terminate in the submaxillary nodes Every now and then these lymphatics are involved by extension of the cancerous growth through them and are felt as thickened strands running over the outer surface of the mandible

The lymphatics of the hard palate are continuous laterally with those of the upper gum. They empty into several stems which pass backward in the midline of the palate, and at about opposite the last molar tooth separate outward to the right and left to pass in front of the anterior pillars of the fauces Here they pierce the superior constrictor of the pharynx and end in the superior deep cervical nodes lying along the internal jugular veins above the posterior belly of the digastric muscle

The lymphatics of the soft palate are numerous and pass toward both surfaces of the palate Those lying below the upper surface join the stems from the nasal mucous membrane below the orifice of the Eustachian tube. Some then pass upward and backward through the superior constrictor of the pharynx into the lateral retropharyngeal nodes while others descend beneath the mucous membrane of the posterior pillars of the fauces, pass through the superior constrictor and end in the upper nodes of the superior deep cervical group (For this description of the lymphatics we have called upon Piersol's Human Anatomy)

Understanding the lymphatic drainage of the mucous membranes of the mouth helps materially in accurately examining for metastases

Treatment of Metastatic Lymph Nodes

Lymph node involvement from primary cancers of the buccal surfaces, upper gums hard palate and soft palate occurs late in the course of the disease Richards (1940) states that 50–60 per cent of cancers of the buccal surface never metastasize at any stage Metastases from the above-mentioned locations occur in the submaxillary nodes and do not spread down the neck as rapidly nor as far as metastases from the tongue and floor of the mouth Metastases from the lower gingiva, in our experience have been somewhat higher than from the other locations in the mouth under discussion This is probably due to the proximity to the lymphatics going over the mandible on the lateral side and to the early invasion of the floor of the mouth by cancers of the lower gingiva It has been our practice, therefore, to refuse any active treatment of the lymphatic drainage areas of the mouth in cases of cancer of the upper gingiva, palates, and buccal surfaces, unless lymph nodes are palpably enlarged and firm enough to suggest metastases. In such cases the treatment is surgical A radical neck dissection should be carried out on the affected side When the primary lesion is on the buccal surface and if it has been eradicated by previous irradiation the dissection is carried up well over the lateral side of the mandible. Cancers of the lower gingiva require radical neck dissection and resection of the jaw together with the surrounding soft parts by means of the composite operation described in Chapter XIX. Further discussion of this operation will not be given here.

Radiation therapy of metastatic lymph nodes in the neck is advised under two circumstances (1) when there is a single node in a patient who is a poor operative risk or who refuses operation Coning down over such a node with an x ray cone and giving 2500-

3000 r is followed by *implantation of radon* seeds. The total dose in the node ought to reach 8 000–10 000 gamma roentgens or r units, singly or combined. (2) The second reason for radiation of lymphatic involvement in the neck is the presence of large inoperable masses. Here the treatment is largely palliative Some times these masses may be reduced in size and become more mobile so that radical opera tive procedures are carried out Frequently *we have seen carcinomas of the buccal surface* and gingiva which were inoperable at the out set become greatly reduced allowing a form of composite operation (see Chap. XIX) Radia tion treatment of these massive tumors consists of 2000–2500 r units in broken doses

TABLE 19

AUTHOR	YEAR	NO CASES	CURED	PER CENT AGE
Martin and Pflueger (radiation therapy)	1935	99	28	30
Simmons (Surgery only—all early cases)	1931	13	6	48
Steiner (Surgery)		33	3	9
Moreatin (Surgery)		26	3	11
Boyd and Unwin	1904	10	4	40
Schreiner and Simpson (radia tion therapy)	1929	30	6	20
Regaud (radiation therapy)		47	9	19
Berven (radiation therapy and endothermy)		81	21	26

through an appropriate port. Treatment factors are 200 Kv 15 Ma filtration ½ mm. Cu 1 mm. Al skin target distance 50 cm Such treatment is followed by implantation of ra dium element needles or radon seeds. The total intratumoral dose should be about 8000–10 000 r

Prognosis

The outlook for a five year salvage of a malignant tumor of the mouth depends upon its location and histological picture and the presence or absence of metastases at the time the patient is first seen There are so many influential factors that it is hard to lay down rules for prognostication In this connection it is interesting to note that the choice of treatment depends largely upon the clincial viewpoint of the therapist In Pack and Livingston s book *Treatment of Cancer and* Allied Diseases C E Richards wrote Chapter XVI from the radiation therapy standpoint and Eugene Polya wrote Chapter XVII from the surgical point of view Polya states on page *366* "Operation is the treatment of choice in every form of buccal cancer" Richards on page *343* gives excellent results varying from 90 per cent five year salvage in stage I to 31 2 per cent salvage in stage III with a total over-all five year *absence of dis*ease of 50 9 per cent We cannot help but agree with Pack and Livingston that the choice of therapy must be governed by the given case in hand We always obtain the best results by such a program and frequently combine radiation and surgery

Richards has summarized in an excellent manner the end results of several clinicians and we reproduce his table by permission of Pack and Livingston and their publishers, Paul B Hoeber and Company (Table 19)

Polya avers that the probability of recur rence "is low in the early small cancers which can be thoroughly burnt out it grows with the advancement of the tumor the malignancy of the buccal cancer standing midway between those of the lower lip and the tongue.' He also feels that the use of electrosurgery diminishes the rate of local recurrence but does not affect the frequency of metastases to ad jacent lymph nodes.

Berven (1937) reports from the Radium Hemet Stockholm results by a method of cross-firing from several external portals com bined with internal application of radium either by interstitial implantation or in the *form of radium tube applicators. He treated* 27 34 24 and 27 cases of cancer of the man dible and gingiva with respective five year cure figures of 11 24 21 and 19 per cent During the same period 43 38 17 and 21 patients were treated for buccal cancer with a five-year cure of 21 32 24 and 24 per cent re spectively These various groups represent pa

tients treated within a given year or period of years all of them five or more years previously

New (1935) in reporting on the treatment of carcinomas of the lower gingiva, states that he had the best results by electrosurgical removal When lymph nodes were involved the five-year salvage was 28 9 per cent, and when the lymph nodes were not involved the five year salvage reached 69 9 per cent The over all salvage was 59 6 per cent out of 151 patients operated on and traced

Paterson (1941) reports a relatively large series of cases of squamous cell cancer of the mouth and divides them into four stages. Stages I and II are small and large lesions with no nodes when first seen stage III, similar cases with operable nodes and stage IV comprises the advanced cases It is interesting that results on the whole show an enormous difference between early and late cases. In the group of cases including cancers of the mouth, except the lips, fauces and base of the tongue, there were 46 per cent of those in stages I and II having no node involvement and 14 per cent of those in stages III and IV with node involvement living after five years. In cases of carcinoma of the cheek the following results were obtained

Stage I	63 per cent
Stage II	46 "
Stage III	18 "
Stage IV	0 "
Over-all total	33 "

In cases of cancer of the palate the results were

Stage I	58 per cent
Stage II	38 "
Stage III	7 "
Stage IV	17 "
Over-all 5-year salvage	35 "

With carcinoma of the alveolus the results were

Stage I	80 per cent
Stage II	48 "
Stage III	26 "
Stage IV	0 "
Over all total	36 "

All of Paterson's cases were treated with radium, either by implantation or intraoral applicators

Nuttal (1943) reports on 442 patients suffering from cancer of the mouth in all stages treated in 1932 and 1933 These included cancers of the tongue, fauces, floor of the mouth, palate, cheek, and alveolus, and were all treated with radium The five year survival rate of node free cases of carcinoma of the palate was 74 per cent of the cheek, 67 per cent and of the alveolus 67 per cent (From the Holt Radium Institute, Manchester, Eng)

New and Hallberg (1941) report on 76 cases of adenocarcinoma (mixed tumor type) of the palate Their treatment is surgical removal with the use of electrosurgery as an adjunct If the tumor is attached to the periosteum, the operation is carried up as far into the nose and maxillary sinus as indicated Radon seeds or radium needles are used at the time of operation in any areas where there is doubt about the complete removal of the tumor By this combination, 93 per cent of the patients lived five years or more and 90 per cent lived ten years or more Irradiation was given as a palliative measure in a few cases. Forty three per cent lived five years and 25 per cent lived over ten years. In twenty three cases in which electrosurgery was used as well as excision of the bone involved 95 per cent lived five years or more, and 76 per cent lived ten years or more.

New and Hallberg use electrosurgical removal as the method of choice for squamous cell carcinomas of the palate. Irradiation is administered directly into all of the involved region when indicated Nine of their 60 cases had node dissection in addition to the treatment of the local lesion. They all showed involvement microscopically Six of these returned for examination and have lived an average of 5¼ years after treatment In histological Grade I (5 cases) there was 100 per cent five year salvage In Grade II 44 per cent in Grade III 38 per cent and Grade IV none The over-all total five-year salvage was 38 per cent

Martin (1942) gives a five-year cure rate in

ninety three cases of cancer of the palate of 23 per cent He uses surgical and electrosurgical removal either alone or in combination with irradiation

Stanford Cade (1949) reports cases treated with radium between 1925-37 as follows

Total treated	Yr 5 per survival
12—Alveolar mucosa	16 6%
34—Buccal mucosa	61 0%
30—Hard palate	53 8%
37—Soft palate	5 0%

In these figures are included operable as well as inoperable cases

Somervell, T H (1944) prefers operative removal in cases of upper and lower gingival carcinoma and radium for buccal mucous membrane cancer in conjunction with electrosurgical or surgical removal The lymph nodes are treated surgically after and not before the local growth is destroyed unless both can be eradicated at the same operation Although no five year results are available, Somervell bases his deductions on 5000 cases of cancer of the mouth and jaws involving 8000 operations during his life in India

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Chapter IX

CANCER OF THE TONGUE AND FLOOR OF THE MOUTH

Cancers of the tongue and floor of the mouth are discussed together for the following reasons

1 As shown in Chapter II on embryology the mucous membrane of the tongue and floor of the mouth develops from the same embryological sources—the first and second branchial arches

2. Many cancers of the tongue have involved the floor of the mouth when they are first seen by the physician especially those located on the lateral border of the middle third, which comprise 58 per cent of all cancers of the tongue.

3 Four per cent of cancers of the tongue arise on the undersurface of the tip many having grown onto the floor of the mouth before treatment is sought.

4 Metastases from the anterior part of the tongue and floor of the mouth follow similar patterns. Carcinoma of the floor of the mouth metastasizes more rapidly than cancer of the tongue because of its proximity to the lymph nodes.

5 Radiation therapy and operative procedures for cancer of the tongue and floor of the mouth present problems requiring an adequate knowledge of similar anatomical structures.

Embryology

A detailed description of the development of the tongue and floor of the mouth is given in Chapter II It is emphasized that the anterior two-thirds of the tongue, that is, from the anterior pillar and circumvallate papillae forward, arises from the first and second branchial arches, and is therefore covered with ectoderm (Fig 245) Between the mandibular or first pair of arches, and the second or hyoid pair of arches, there appears at the fifth week of fetal life a single protuberance called the *tuberculum impar* This is likewise covered by ectoderm and gradually merges with the lateral two portions to form the main body of the tongue

The mucosa of the root of the tongue arises from the entoderm in the region of the copula, a median ventral elevation formed by the union of the second or hyoid arch with later additions from the third and fourth arches. The root becomes infiltrated with lymphoid tissue and is concerned with swallowing

Since the body or anterior two-thirds of the tongue is covered with ectoderm, the type of cancers arising in it are histologically different from those found developing in the base the mucous membrane of which comes from entoderm Carcinomas on the anterior two-thirds of the tongue are more differentiated squamous cell tumors. Those on the posterior third or base of the tongue are less differentiated and more anaplastic. Also they apparently metastasize more rapidly than those in front of the circumvallate papillae and are more sensitive to radiation therapy while those on the anterior two-thirds, being more differentiated are less radiosensitive On the other hand anterior cancers, being more accessible yield to surgical removal and irradiation much better than those in the posterior third of the tongue.

Anatomy

For clarification of problems of diagnosis and therapy particularly surgical operations, a few anatomical considerations of the tongue are reviewed The tongue is a muscular organ completely filling the mouth when the latter is closed and attached to the floor of the mouth the symphysis of the jaw by the genioglossus muscle and to the body and both horns of the hyoid bone by the hyoglossus muscles. The tip is the anterior end which

may be protruded from the mouth at will The anterior two-thirds is called the body and comprises that portion in front of the anterior pillars and circumvallate papillae The base is that portion back of the circumvallate papillae and anterior pillars attached to the hyoid bones on each side The mucous membrane covering the tongue is of the squamous cell type closely beset with elevations, or papillae which are of three varieties the fungiform papillae as red points chiefly near the edges while the filiform are everywhere but arranged

The mucous membrane of the tongue contains serous and mucous glands.

Because of its variable and valuable uses, any permanent injury to the organ often causes embarrassment by inarticulous speech and malnutrition from inability to swallow properly

BLOOD SUPPLY

The main arterial supply is furnished by the lingual branch of the external carotid aug mented by branches from the external maxillary and ascending pharyngeal The blood sup-

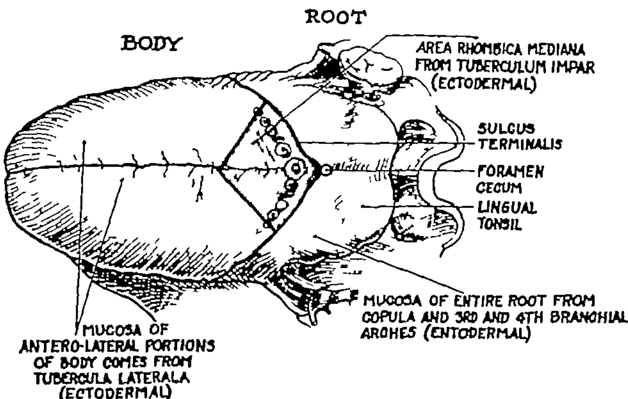


Fig. 245 Diagrammatic representation of embryological source of various parts of adult tongue (From "Tumors of the Tongue" by Ward and Duff Courtesy Cyclopedia of Med. Surg. & Specialties. F A Davis Co)

in parallel rows continuing forward from the circumvallate papillae The circumvallate papillae are usually from nine to ten up to sixteen and arranged in the shape of a V with the apex posteriorly just in front of the foramen cecum According to Piersol, these papillae are of special interest as being the most important seat of gustatory end organs, or taste buds

There are no papillae back of the foramen cecum but the surface of the base of the tongue is studded by lymphoid tissue which along the edge forms the lingual tonsil

ply is bilateral and except for a few cross anastomoses at the tip there is no communication of any consequence between the two sides hence ligation of either artery will reduce greatly the amount of bleeding which occurs during an operation Ligation of the lingual artery is required frequently as a preliminary step to extensive operation and also to check severe hemorrhages following ulceration from malignant tumors or sloughing following intense local irradiation It is an advantage therefore in selected cases to ligate the lingual

or external carotid artery either on one or both sides, depending upon the location of the disease, as a prophylactic measure before heavy local irradiation. In several of our cases the tip of the tongue sloughed following bi lateral simultaneous ligation of the external carotid arteries When bilateral ligation is in dicated, the arteries should be tied off a week or ten days apart

The veins consist of four sets on each side communicating freely with one another

1 The dorsal veins, forming a submucous plexus on the back of the tongue

2 Two veins accompanying the artery

3 Two with the lingual nerve

4 Two with the hypoglossal nerve

NERVES

The motor fibers are supplied by the hypoglossal and the common sensation from the lingual branch of the fifth supplying the an terior two-thirds and from the glossopharyn geal to innervate the remainder, excepting the region in front of the epiglottis, which is supplied by the superior laryngeal from the vagus. The chief fibers of special sense are derived from the glossopharyngeal

LYMPHATIC DRAINAGE

The tongue itself is drained by abundant lymph vessels into submental and cervical nodes by four main groups

1 Apical, from the tip of the tongue to the submental suprahyoid and the principal node of the tongue.

2 The lateral group from the margin passes down through the mylohyoid muscle into the submaxillary and others into the deep superior cervical nodes lying along the jugular vein

3 Basal which pass from the posterior por tion of the organ particularly in the region of the circumvallate papillae to the superior cer vical node

4 Median—a few vessels pass through the mylohyoid muscle to reach the submaxillary salivary gland while a large portion pass around the posterior border of the muscle and enter the substance of the deep cervical nodes.

The principal node of the tongue is located at the bifurcation of the common carotid artery (Fig 246), or perhaps higher, opposite the angle of the jaw and receives its name from the fact that so many lymphatics run into it from all parts of the tongue The superficial and deep cervical nodes and the submental and submaxillary nodes, however are so abun dantly connected with lymph channels that metastases from the tongue reach almost any part of the neck Therefore, all portions of the neck should be carefully palpated in a search for enlarged cervical nodes in the presence of cancer or any other diseases of the tongue Radical operation upon the lymph nodes of the neck which might be involved from cancer of the tongue means removal of the entire cervical lymphatic system from the midline in front back to the edge of the trape zius muscle taking in both the anterior and posterior triangles and from the jaw and mastoid process above to the clavicle below Often there is a lymph node just above the point where the stylohyoid and posterior belly of the digastric muscle cross the internal jugular vein, therefore, the dissection must be carried up practically to the base of the skull

SQUAMOUS CELL CARCINOMA

INCIDENCE

In 1938 1115 persons died from cancer of the tongue in the United States (Bureau of the Census Vital Statistics Special Report Vol 9 No 25 p 173) Nine hundred forty three of these deaths were in males and 172 in females There were no deaths from cancer of the tongue under twenty years of age There were four deaths from twenty to twenty nine twenty-one deaths from thirty to thirty-nine and four deaths in patients over ninety years of age The largest number of deaths for any one decade (sixty to sixty-nine) was 363 In that same year the total number of deaths in the United States from cancer and other malig nant tumors was 149,214 or a total death rate from tongue cancer of 74% of all cancer deaths

The report does not separate cancers of the floor of the mouth It also states that cancer of the "mouth" caused 570 deaths of all cancer deaths or about one-half of the total death rate from tongue cancer The word *mouth* includes cancer of the buccal surface as well as floor of the mouth cancer of the gum besides unspecified parts of the buccal cavity and pharynx, which is given in separate figures

Martin Munster and Sugarbaker (1940) in reporting on 1500 cases of cancer of the tongue in the records of the Memorial Hospital in New York, report that cancer of the tongue comprises about 15 per cent of all tumors of the upper respiratory and alimentary tracts and about 25 per cent of all intraoral tumor They feel that cancer of the tongue makes up between 2 and 3 per cent of all human cancer

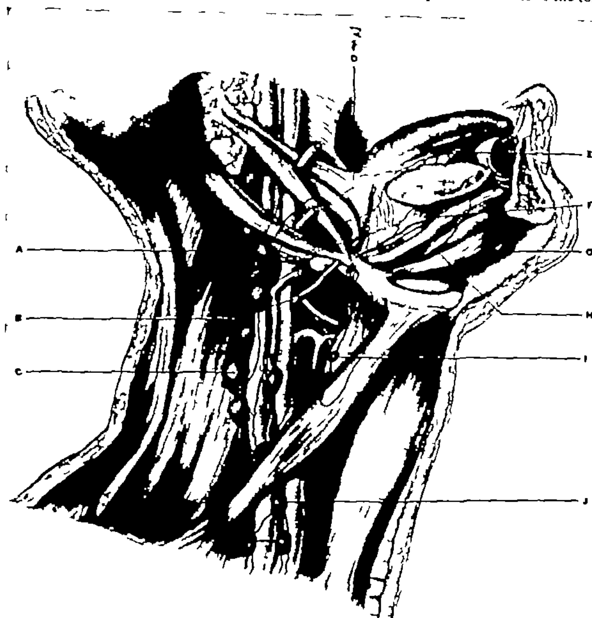


Fig. 246. Primary lymph node groups draining the tongue and floor of the mouth. (A composite picture redrawn from Poirier with additions.) A. Principal node of tongue B lingual artery winding its way up over hyoid bone and along floor of mouth C, superior deep cervical nodes D basal group of lymphatic vessels E and H apical lymphatic vessels F, lateral vessels G submental node I intercalated nodes J inferior deep cervical nodes. (From "Tumors of the Tongue" by Ward and Duff Courtesy Cyclopedia of Med Surg & Specialties F A. Davis Co.)

Martin and Sugarbaker (1940) estimate that cancer of the floor of the mouth "is about half as frequent as cancer of the tongue" and that "cancer of the floor of the mouth comprises 17 per cent of all intraoral tumor, 7 per cent of all cancer of the upper respiratory and alimentary tracts and 1.43 per cent of all admissions for cancer." In the Texas Cancer Bulletin 1948, No 1 we read that cancer of the tongue causes more deaths than any other epidermoid carcinoma of the head and neck

Location of the Primary Growth

The most common site of carcinoma of the tongue is along the lateral border of the middle third Next in order of frequency is the base or posterior third, then the anterior third, and least common of all is the undersurface of the tip We have never seen a case of cancer of the tongue beginning in the area rhombica mediana in front of the circumvallate papillae It is interesting that this area arises from the tuberculum impar, a protuberance lying in the middle between the first, or mandibular and second or hyoid branchial arches. This sacculated mucosa from three sources pushes upward and forward later becomes infiltrated with striated muscle originating from the mesoderm caudally and dorsally near the spine, and innervated by the hypoglossal nerve. Other observers state that they have never seen a cancer arise primarily in the area rhombica mediana although cancer from the lateral borders or posterior part of the tongue grows into this area. We have had three cases of benign papilloma arising in this area, two in boys and one in an adult male (see Chapt VII) It is interesting to speculate why benign papillomas are seen here but not true cancer Carr reports a case of squamous cell carcinoma of the tongue developing in leukoplakia and almost in the center of the anterior third of the tongue a rare occurrence

Cancer of the floor of the mouth usually arises in the anterior portion of the floor and most commonly at the junction of the tongue and floor of the mouth Occasionally a carcinoma begins in a papilloma in the region of Wharton's duct One of our cases in a young woman twenty six years of age arose in the floor of the mouth opposite the molar teeth on the right side

Histology

For the most part, cancers of the anterior two-thirds of body belong to the more highly differentiated squamous cell groups (Grades I and II) Undifferentiated and transitional cell carcinoma are seen in the body of the tongue less commonly The latter infiltrate rapidly, spread through the lymphatics to the adjacent nodes with a consequent markedly reduced prognosis. According to Martin Munster, and Sugarbaker, 80 per cent of the cancers in the base of the tongue are non-keratinizing

Spindle cell epidermoid carcinomas, adenocarcinomas, adenocystic basal cell carcinomas, occur occasionally in the tongue but need not be considered in statistical cancer studies Prognosis of this rarer type of cancer is poor, as recurrences develop rapidly and these tumors are more resistant to irradiation therapy than the squamous cell variety of the anterior two-thirds or the more anaplastic and lymphoepithelioma types of the base of the tongue.

Duffy (1940) gives the following instructive Table, which we reproduce by permission of the authors and publishers, summarizing the gradation of tumors of the tongue and the location of metastases in percentages (Table 20)

Since the epithelium of the base of the tongue arises from the primitive foregut and is therefore entodermal in origin, a more detailed description of the histology of cancers in this region will be discussed in Chapter XII dealing with cancer of the pharynx and base of the tongue Tumors here respond to radiation therapy more nearly like those in the hypopharynx than like tumors in the anterior two-thirds of the tongue

Cancers in the floor of the mouth are, as a rule less highly differentiated than those on the tongue Again these are most all squamous cell carcinomas of the keratinizing type Martin and Pflueger find that the radiosensitivity of floor of the mouth cancer is higher than that of the anterior portion of the tongue or the mucosa of the cheeks. Cancer of the floor

of the mouth resembles more nearly in its radiosensitivity cancers in the base of the tongue and pharynx. There is no adequate explanation for this fact from a histological standpoint. Our experience somewhat verifies the assumptions of these authors relative to the radiosensitivity of tumors in the floor of the mouth as compared with those on the tongue. On the other hand the proximity to the jaws and the technical difficulties of irradiating tumors in this area without injury to the jaws renders their prognosis in our hands graver than the prognosis of cancer on the tongue. Also the lymphatic drainage of the floor of the mouth is shorter in its route to the lymph nodes of the cervical region thus permitting more rapid spread and reducing the prognosis.

TABLE 20

GRADATION OF TUMOR AND LOCATION OF METASTASES (IN PERCENTAGES OF PATIENTS DEVELOPING METASTASES) IN CARCINOMA OF THE TONGUE

LOCATION OF CANCER	GRADATION OF TUMOR: Grade I (per cent)	Grade II (per cent)	Grade III (per cent)	Transitional and lymphoepithelioma (per cent)
Tip of tongue	28 5	57 2	14 4	0
Dorsum of tongue	56 2	37 5	6 2	0
Lateral border of tongue	22	75	3	0
Base of tongue	4	66	9 5	20 4

LOCATION OF CANCER	LOCATION OF METASTASES: Sub-mental nodes (per cent)	Submaxillary nodes (per cent)	Upper deep cervical nodes (per cent)	Carotid nodes (per cent)	Opposite side of neck nodes (per cent)	Bilateral nodes (per cent)	Distant metastases (per cent)
Tip of tongue	5 3	31 6	5 3	26 4	10 5	20 9	0
Dorsum of tongue	0	6 8	59 6	13 5	0	20 1	0
Lateral border of tongue	0	31 5	20	37 1	0	11 4	2 6
Base of tongue	0	1 3	53	24 7	0	21	4 9

ETIOLOGY

The cause of cancer of the tongue is not understood. Although many irritating factors are given as contributory causes the same irritations occur in many patients who do not develop cancer. It would seem logical to suppose then that more than one factor enters into the cause and development of cancer of the tongue. Not only are irritations stimulating to growth but there must be that unknown biological factor in the host in order that trauma may excite the cancer.

Chronic Irritation. Ragged teeth, poorly fitting dentures produce mechanical trauma which when continued for a long time may be exciting stimuli for cancer. Sharp and Spickerman after studying eighty-one cases, state that dental factors are more directly responsible for lingual cancer than any other single cause.

Around such sites of chronic irritation, there is epithelial hyperplasia often appearing like leukoplakia. Frequently, this leukoplakic looking area will disappear after the irritation is removed.

Leukoplakia. The word *leukoplakia* means *white patch*. A more detailed discussion of this disease is given in Chapter VII on benign and premalignant lesions of the oral cavity. The tongue is a frequent site for leukoplakia in the location always to be considered a premalignant lesion. (See Color Plate IV.) Around many cancers of the tongue there is some leukoplakia (epithelial hyperplasia) of a greater or lesser degree. It is difficult to determine whether the leukoplakia in such patients is secondary to the cancer or the cancer pre

ceded the leukoplakia. An accurate history from an intelligent observin patient may assist in determining which came first the leukoplakia or the cancer Acute leukoplakia of a few weeks' or months duration is the most likely type to develop into cancer the biolog ical factors causing the leukoplakia seem to continue rather rapidly the hyperplasia of the epithelium into true cancer

Tobacco The use of tobacco either by smoking or chewing causes chronic irritation of the oral mucous membrane Here again in the proper biological setting tobacco may be a contributing cause to the development of tongue cancer in spite of the fact that many people smoke all their lives and do not develop cancer in the mouth. Sharp and Spickerman, in reviewing eighty-one cases of tongue cancer seen in private practice and the Veterans Hospital in California found excessive smoking in one-third of the patients. Such statistics are of questionable value as 87 per cent of the male population smoke (Hayes Martin, see Chapt VI)

Papilloma and Other Benign Tumors. Since the tongue is subject to chronic trauma by teeth that may or may not be rough and ragged by dentures by smoking and by other causes, any benign tumor of the tongue should be removed as soon as discovered *Papillomas* or epithelial warts of the tongue are particularly dangerous, as they represent an abnormal growth which, under the stimulation of irritation may undergo malignant change (see Chapt VII)

Syphilis. The association of syphilis with cancer of the tongue has been discussed in the medical literature at considerable length It would seem that the percentages given (20–40%) vary with the level of population studied by the various authors. In clinic practice one would expect a higher percentage of syphilis than in private practice We have found this to be our experience

Syphilis of the tongue when related to cancer is in the tertiary stage Two types are seen one is a punched-out ulcer resulting from the rupture of a gumma The location is usually in the center of the tongue, as opposed to carcinoma which more frequently affects the edges or the floor of the mouth The edges of the gumma, or punched-out ulcer are soft, may be raised and overhanging Since the punched-out ulcer represents a broken-down gumma, there is much sloughing and discharge of dirty pus There is no pain a symptom which differentiates from tuberculosis but not from cancer in the early stages Palpation with a gloved finger may elicit a firm or hard area, requiring biopsy to rule out early cancer in the gumma The gummas heal and leave scars The repeated healing of gummas results in a nodular tongue with leukoplakia here and there and associated atrophy of the papillae (Fig 247 A and B) Ward and Duff (1940) suggested the name cobblestone tongue , a term similar to the one used to describe a nodular liver

The second type of syphilitic tongue frequently the seat of cancer appears as a chronic glossitis. There is atrophy of the papillae, so that the edges of the tongue particularly, have a shiny glistening appearance Scattered over the tongue are patches of leukoplakia This combination of leukoplakia and atrophy are so characteristic as to be almost pathognomonic of syphilis (Fig 198)

Clinical Behavior

The first symptom of cancer of the tongue or floor of the mouth is most often the discovery of the primary lesion This discovery may be accidental, or more commonly the patient feels something abnormal on the tongue or in the floor of the mouth The average intelligent patient notices the primary lesion when it is early It is strange on the other hand, how frequently clinic patients come with a large ulceration in the tongue or on the floor of the mouth and metastatic nodes, both of which must have been present for many months and yet give the story that the ulcer was noticed a few days or a few weeks prior to admission (Fig 248 A and B) Evidently the power of observation in these patients is so low that they ignore the abnormal sensa

tions in the mouth which the more intelligent and fastidious patients pick up early



Fig 247

A. "Cobblestone tongue," a manifestation of tertiary syphilis. Blood test positive. Superimposed leukoplakia.

B Well-differentiated squamous cell carcinoma developing in the tongue lesion of syphilis. (See also Fig 202) (Figs. A and B Courtesy F A. Davis Co. Cyclopedia of Med., Surg & Specialties.)

Other patients date their present illness to the irritation of the tongue by a ragged tooth or ill fitting denture Rarely does a single trauma of the tongue represent the onset of the cancer

The appearance of a nodule in the submaxillary or upper cervical region is often the first symptom Particularly is this true when the primary site is the floor of the mouth or the base of the tongue Local symptoms in the latter region are rarely present and the inability of the patient to observe this portion of the

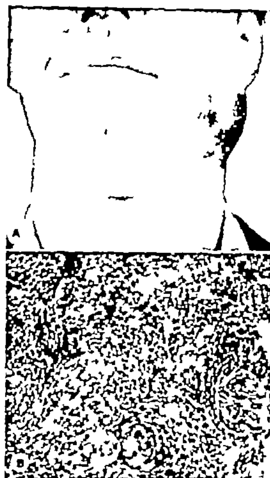


Fig. 248

This patient was sent with a clinical diagnosis of mixed tumor of the parotid gland While being examined it was noticed that he talked with a thick accent and with difficulty Examination of the mouth showed an ulcerative growth involving the posterior part of the floor of the mouth and extending up on the tongue

B Photomicrograph shows moderately differentiated squamous cell carcinoma.

tongue permits the cancer to grow to an extensive size before it is noticeable

Pain is rarely a primary symptom of cancer of the tongue we have seen it only when the primary lesion began in the lower layers of the mucosa and the tumor grew down into the tongue ulcerating late in the course of the disease most commonly in the base

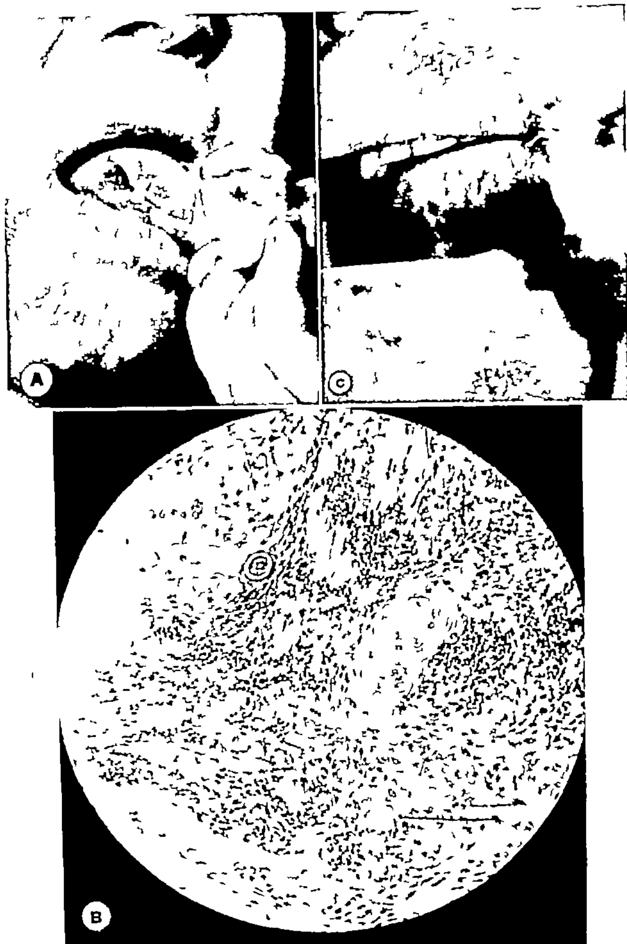


Fig 249

A. Malignant ulcer of the tongue (squamous cell carcinoma) complicated by syphilis. Positive STS confused the diagnosis and patient was sent for biopsy 2 weeks after no response to antisyphilitic treatment.

B Photomicrograph of tissue removed from patient shown in "A."

C Healed after electrosurgical excision. This patient was treated about 15 years ago before we routinely excised lymph nodes in the neck He was followed for several years without recurrence or metastases. (Courtesy F A. Davis Co. Cyclopedia of Med., Surg. & Specialties.)

CLINICAL TYPES OF SQUAMOUS CELL CARCINOMA

Cancer of the tongue is most frequent along the lateral border in the middle third next is the base then the anterior third and last the undersurface of the tip and floor of the mouth The gross appearance of the primary lesion may be one of four types First the most common is an ulcer (Fig 249 A B and C and Fig 250 A and B) In the early stages the ulcer is clean the base roughened and the edges elevated indurated and hard. At first there is little invasion of the underlying muscle but later the induration extends more deeply into the tongue or floor of the mouth Not uncommonly the induration extends out beyond the edges of the ulcer not discernible to the naked eye Digital palpation with a gloved finger is essential in determining the outlying borders of the growth under the surrounding mucous membrane

The second type is the so-called *infiltrating carcinoma* (Fig 251 A and B and Fig 252) Histologically the infiltrating type is usually less well-differentiated than the ordinary ulcer and therefore much more rapidly growing It extends out through the lymphatics and between the muscle fibers early producing firm induration at a distance from the visible ulcer and widespread cervical metastases. The prognosis in these cases is bad (Fig. 253 A–C) The third or papillomatous type is most commonly seen on the tip of the tongue and occasionally on the floor of the mouth (Fig 254 A C) beneath the tip These growths really are malignant papillomas (see Chapt VII) Histologically they are well-differentiated with marked hyperkeratinization and epithelial pearls. They involve the submucosa muscles, and lymphatics late The prognosis is good for they are radiosensitive and are readily removed with a wide safe margin



Fig 250

A Ulcerated squamous cell carcinoma of the floor of the mouth. This type is very difficult to treat because of the location and proximity to the jaws. Heavy radiation causes radio-osteonecrosis in a very high percentage Bilateral metastases are frequent.

B Photomicrograph. Well-differentiated squamous cell carcinoma.

The fourth and most uncommon type are the non-ulcerated carcinoma, usually beginning with pain and occurring at the base of the tongue or far back along the lateral margin. Many years ago one of us (G E W) observed, with the late Curtis F Burnam, a patient who was under treatment for polycythemia vera.



Fig. 251

A. Infiltrating type of squamous cell carcinoma of the tongue Note the thickness of the tongue around the ulcer and extending back toward the midline.
B. Photomicrograph showing moderate cellular differentiation.

He complained of severe pain at the base of the tongue Repeated visual examination with a throat mirror revealed no ulceration It was not until the base of the tongue was examined with a finger that a hard nodule was felt Later this ulcerated and proved to be squamous cell carcinoma on biopsy A more recent case was referred by Paul H Royse because of a painful, hard non ulcerated lump on the left side of the tongue just in front of the anterior pillar Diagnosis was made by incisional biopsy The tumor responded well to external radiation with x ray and interstitial implantation of radon seeds. A third case, referred by the late Robert Bay, came complaining of a thick painful tongue About four fifths of the tongue was involved by an infiltrating mass which showed one or two small areas of secondary ulceration. Evidently the tumor had begun deep in the tongue and the ulcerations were late Thus

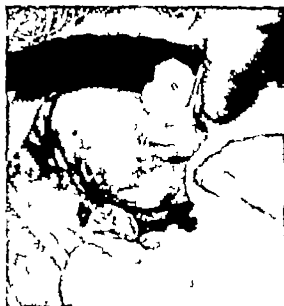


Fig 252

Infiltrating carcinoma at the junction of the tongue and the floor of the mouth. This type gives a very poor prognosis because it invades the muscle and lymphatics early and metastasizes quickly and often bilaterally

patient remained well for many years after implantation of 48 mc. of radon

EXAMINATION

Although in Chapter I a section is devoted to examination of patients with tumors of the head and neck certain points in the technic of examination of the tongue and floor of the mouth are repeated for emphasis The following points should be noted protrusion in the midline atrophy of musculature or mucous membrane, irregularities in the surface coating tumors ulcerations the type of ulcer, whether clean punched-out dirty overhanging edges elevated piled-up edges, nodular or

smooth base redness or an inflammation around the edges Every symptomatic tongue should be carefully palpated with a gloved ticularly important is palpation of the base of the tongue to ascertain the extent of the disease in all directions into the vallecula out into the



Fig 253

A. Squamous cell carcinoma of the floor of the mouth Grade IV metastases to the cervical lymph nodes. Later metastases occurred to the scapula, ribs and right iliac crest.

B Cervical swellings indicating enlarged lymph nodes.

C Photomicrograph showing anaplastic type of tumor

finger The consistency of the lesion will be noted and any extension of the disease process beyond the scope of the eye is detected Par lateral pharyngeal wall deep into the base of the tongue anteriorly The floor of the mouth must be palpated bi-digitally with one finger

of one hand in the mouth and the fingers of the other hand beneath the jaw in the submental and submaxillary regions. Often, early involvement of lymph nodes is detected by bimanual palpation which might be missed by palpation

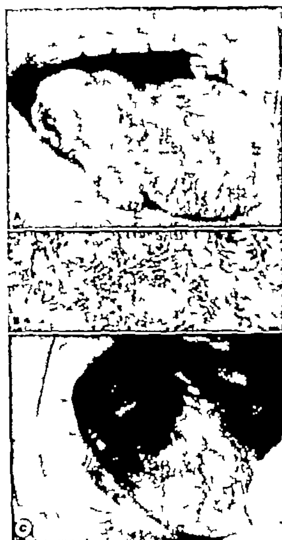


Fig. 254

A. Papillary carcinoma of the tongue, recurrent after surgical excision at another hospital.

B Photomicrograph of highly differentiated type of carcinoma developing in papilloma.

C. Radiation epithelitis. Patient operated by pull through composite technic. Histological examination revealed no growth

through the skin only The normal submaxillary salivary gland is palpable as a rubbery discrete somewhat irregular lump in the submaxillary area midway between the center of the chin and the angle of the mouth In about 50 per cent of normal individuals small soft lymph nodes are felt in the submaxillary region

One of our associates (Inui) called attention to a method of identifying lymph nodes in the region of the external maxillary artery and vein The fingers are slipped under the middle of the mandible and soft tissues rolled against the bone as the fingers are brought over the jaw When an enlarged node is present, it will be felt to slip under the finger as it is forced up over the lower border of the jaw

Since the tongue and floor of the mouth are easily accessible and since most cancers are ulcerated, there is no excuse for beginning any kind of treatment of a chronic lesion without *biopsy* Biopsy is either by excision of an adequate piece of the edge under local anesthesia or by biopsy forceps (Fig 255) without anesthesia

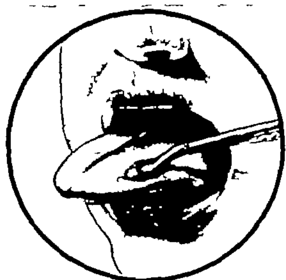


Fig. 255 Method of obtaining biopsy from tongue carcinoma, using biopsy forceps. No anesthesia is necessary and pressure with a gauze sponge or electrodesiccation controls oozing (Courtesy F A. Davis Co)

The object of all biopsy is to furnish enough tissue for pathologists to determine the relationship of the disease to the surrounding structure and to identify the specific type of lesion at hand One cannot stress too strongly the importance of obtaining an adequate amount of characteristic tissue Biopsy of infected, sloughing areas is valueless. A site free of slough and near the edge of the growth or ulcer is chosen in order to obtain normal tissue as well as the pathological process After all the pa

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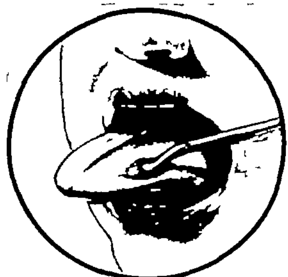


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thologist can make a diagnosis only on what the clinician submits to him for study

Differential Diagnosis

As a rule acute ulcers and infections in the tongue do not enter into the differential diagnosis of cancer The three most common chronic ulcers requiring differentiation are syphilis, tuberculosis and cancer

Tertiary syphilitic ulcer results in the rupture of a gumma Consequently there is foul dirty discharge and ragged overhanging edges. The ulcer is soft and there is no pain A history of syphilis often leads to the suspicion of the disease The presence of atrophy of the papillae, scarring and nodulation of the tongue and a characteristic type of rather smooth leukoplakic spots add to the diagnosis. The final diagnosis of course is based on serological studies for syphilis and *biopsy*

Tuberculosis in the tongue, as elsewhere in the mouth is usually painful We have only seen two cases in which pain was not a prominent symptom In the tongue the tuberculous ulcer may be superficial or deep the base clean and nodular the edges are soft and may or may not be overhanging Diagnosis is made by biopsy x ray of the chest and sputum examination Tuberculosis of the tongue like tuberculosis in the mouth, is practically always secondary to tuberculosis in the upper respiratory tract The implantation of the disease into the tongue occurs at the site of a break in the mucous membrane The infected sputum contaminates the wound and a tuberculosis ulcer results

In cancer the ulcer may be small or large It is painless in the early stages and the base is then usually clean The edges are elevated and indurated because there is active proliferation of tissue a histological consideration which differentiates cancer and its clinical signs from infection The edges may be coxcomb There is an outgrowth of tissue due to the very nature of the neoplastic process (new growth) *Infections are destructive Cancer is a constructive process in that it develops new tissues*, at the expense of the host Sloughing and *secondary infection occur when the blood supply is outgrown by the neoplastic process itself*

Other lesions to be differentiated are

Papillomas are *not uncommon on the tongue.* When the base is not infiltrated and if the papilloma is movable, benignity is probable However the only final arbiter of the diagnosis is adequate biopsy

Functional disturbances. Glossodynia is a very common affection unaccompanied by visible change in the tongue but often causing great fear of cancer The burning sensation is usually along the side but occasionally on the tip Many patients have had a general physical examination including blood count serological test for syphilis, and in some cases, gastrointestinal studies with negative results. There may or may not be redness or atrophy of some of the smaller papillae

Canker sores begin usually as a blister later the top sloughs and a small superficial ulcer results. These may or may not be multiple on the tongue and in the mouth. They are of short duration There is no excavation or induration blood studies are negative biopsy is usually not necessary as the process is characteristically painful and shortlived

Vincent s angina occurs on the tip and edge of the tongue as a red inflammed area, containing small ulcers and a grayish slough The lesion is tender painful and usually associated with fever and malaise. Differential diagnosis is made by bacteriological examination serological test for syphilis, and physical signs

Chronic glossitis may be local or general. It is not uncommon along the side of the tongue in the middle third or on the dorsum Ulceration may or may not be present The lesion is soft the edges are not elevated Biopsy and bacteriological studies and serological test for syphilis make the diagnosis

Spontaneous abscess of the tongue is rare but when present the symptoms are characteristic acute *painful swelling with redness and* mild fever The abscess is so tender that palpation is difficult and exceedingly painful There

is dysphonia and dysphagia. The acuteness of the onset is characteristic and the disease should not be confused with cancer

Mycotic infection occasionally occurs in the mouth and tongue, as a part of an involvement of the buccal mucous membrane and soft tissues of the lower jaw History may reveal a puncture wound of the tongue with a straw or beard of some grain usually occurring in farmers or dairymen A hard granuloma develops usually on the dorsum and gradually, without much pain involves the deep muscles. After softening of the mass, periodic discharge of pus occurs through multiple sinuses. Minute "sulfa granules" can be seen grossly in the pus and microscopic examination confirms the diagnosis.

Infected lingual tonsils. Frequently patients come in with a fear of cancer because of a red, tender hypertrophied bit of lymphoid tissue at the junction of the anterior pillar of the fauces with the tongue These lesions are soft, usually covered with mucous membrane, and may be associated with inflammation of the adjacent circumvallate papillae In any doubt biopsy

Traumatic ulceration usually follows a history of injury most commonly from teeth The lesions are painful the edges are not elevated and there is no induration Healing is prompt when irritation is removed Delayed healing requires biopsy and a serological test for syphilis.

Median rhomboid glossitis is always located in the area rhombica mediana in the V of the circumvallate papillae The lesion is dark red dish-brown in color with atrophy of the papillae giving a smooth and glistening surface There is no pain and the lesion is unobserved unless the patient looks at his tongue. On palpation the consistency is about that of the remainder of the tongue On histological section there is a chronic inflammatory reaction beneath a rather hyperplastic mucous membrane The lesion is of unknown etiology and has no clinical significance

Black hairy tongue is usually located on the dorsum from the middle to the back, appearing as a dark brown to-black, hairy area There is no induration, no ulceration, no pain or discomfort The lesion is due to hypertrophy, hyperkeratosis and pigmentation of the papillae filiformes.

Geographical tongue is a disease of unknown etiology, formerly thought to be of syphilitic origin Atrophy of the papillae occurs in one or more areas simultaneously, leaving a pink spot with a white edge Gradually these areas enlarge and coalesce to form an arbor vitae pattern, hence the name of geographical tongue

Other benign lesions are dealt with in the chapter on benign tumors of the oral cavity

Lymphosarcoma is very rare in the tongue. Ewing (1928) quotes Scheiniger as having collected four cases in the literature. The lesion is nodular, ulceration may or may not be present and there is induration. Biopsy confirms the diagnosis.

Sarcoma is exceedingly rare but reported in the literature Biopsy makes the diagnosis.

Metastatic carcinoma of the tongue does not occur except by extension to the base of the tongue from lesions of the nasopharynx or tonsillar pillars above, or vallecula and hypopharynx below These lesions must be carefully examined and the origin of the growth excluded before the base of the tongue can be considered primary Likewise carcinoma of the floor of the mouth and gingiva may extend to the body of the tongue

TREATMENT

A monumental treatise of Diseases of the Tongue was written by Henry T Butlin, Assistant Surgeon and Demonstrator of Practical Surgery in Diseases of the Larynx at St. Bartholomew s Hospital in London in 1885 All persons interested in this subject should by all means study this book as well as a subsequent edition by Butlin and Spencer in [illegible] and a 3d edition by Spencer and [illegible] in 1931 It is interesting that on page 292 of [illegible] original volume, he has the following [illegible] about early diagnosis of cancer [illegible] will recognize certain present-day [illegible]

which are being emphasized in order to make the diagnosis.)

"With regard to the general subject of early diagnosis of cancer of the tongue I am glad to believe that the attention of the profession and of the public is much more keenly directed to the importance of it, than was the case even a few years ago Until the last few years, the practice was almost universal in the profession to regard carcinomatous ulcer as probable then possibly an ulcer of some other kind until it was very clearly proved to be a carcinoma by unmistakable signs, such, for instance, as the implication of adjacent structures, the adhesion of the tongue to the floor of the mouth, and the enlargement of lymph glands I do not mean to say that all of the cases which were seen by surgeons of large experience attached to hospitals were treated in this fashion yet, even among them, there was a fatal tendency to do what is commonly termed give the patient a chance by treating the disease on the assumption it was syphilitic or simple Gradually medical men are coming round to the belief that to give the patient a chance means, under such circumstances, to give the carcinoma a chance, of obtaining a firm and irresistible hold and to take all chance of complete recovery from the patient. Without doubt, the tendency which now prevails among surgeons to operate early and even in doubtful cases, depends to a large measure on the greater knowledge which we have of good and safe methods of removing the whole or a part of the tongue The operation, especially when only a segment of the organ is removed, is no longer regarded as a difficult or very dangerous operation. Owing partly to the circumstance partly to the fact that practitioners of all kinds are beginning to recognize the extreme danger of delay in doubtful cases, I have observed of late a disposition to recommend the removal of what would formerly have been regarded as insignificant warts and lumps, and sores. In my own practice and in that of my hospital colleagues, several cases of this kind have occurred within the last year or two. An almost trivial operation has been practiced and the fear may sometimes almost certainly of a horrible death from lingual cancer has been averted."

If this advice of Butlin had been followed down through the years and all small premalignant lesions removed many lives would have been saved the horrible death from lingual cancer

Butlin goes on to advise the removal of irritation in the form of bad teeth and the elimination of tobacco in cases where there is frank irritation or slight ulceration in the mouth Today the best treatment for cancer of the tongue is prevention by removal of all forms of irritation and apparently harmless growths that appear on the tongue from time to time. Education of the general public and the medical profession to the value of constant observation of the tongue to watch for danger signals is a first step in the treatment of cancer of the tongue

The earliest form of active treatment of frank cancer of the mouth was surgery and by surgery we mean excision of the primary growth with the scalpel or actual cautery Butlin gives the following interesting and instructive résumé of the early development of surgical treatment of tongue cancer Imperhelle who died in 1658 was probably the first to excise the tongue with success Gradually the operative procedures which were at first irregular took on definite design through various stages of the development Langenbeck C J in 1819 introduced wedge-shaped excision of diseased parts of the tongue with careful suture of resulting flaps Mirault introduced preliminary ligature of lingual artery, to give a clear bloodless field for extensive excision The division of the cheek was first described by Jaeger in 1831 This was done to give ample exposure to the tongue Roux, who died in 1836 was the first to divide the lower jaw and lip in the midline in order to gain free access to the floor of the mouth and tongue Billroth in 1862 divided the jaw and soft parts at the side in two places and turned down the flap of skin and bone so formed replacing and wiring the bone afterwards B von Langenbeck in 18/5 divided the jaw and soft parts opposite the first molar tooth on each side in order to gain access to the side of the mouth for removing the tongue gland and part of the palatal arches and tonsil The inframaxillary operations were introduced by Regnoli in 1838 He opened the floor of the mouth from below by an incision from the middle of the hyoid bone to the chin ending in another semilunar incision along the border of the jaw The tongue was drawn through the opening and the sides" Czerny in 1870 modified Regnoli s procedure forming lateral flaps Billroth in 18 1 76 modified it still

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It is interesting that B von Langenbeck in 1875 and Kocher in 1880 described the removal of lymph nodes, along with the primary growth in the tongue, prior to Halsted's epoch making radical breast operation, in which the breast pectoral muscles and axillary contents were dissected in continuity Subsequently we shall describe a method of removal of the lymph nodes in the entire involved side of the neck together with the primary growth in continuity, following the basic work of these men many years ago (Chapt. XIX)

Choice of Irradiation or Surgery for Cancer of the Tongue and Floor of Mouth

We now employ preoperative irradiation therapy followed by hemiglossectomy and neck dissection en bloc, either by the composite operation or pull-through operation for tongue and floor of the mouth cancer, in preference to local operation alone for most cases The exception are (1) small cancers on the tip of the tongue particularly of the papillary type. These tumors are slow to metastasize and do not infiltrate the submucosa and muscular coat and therefore yield well to surgical excision (2) Aged and debilitated patients who are poor operative risks. (3) Patients who refuse surgical procedures. (4) Small early growth of low histological grade and without palpable lymph nodes which respond exceptionally well to radiation therapy Patients in this category must be observed frequently for recurrences and metastases Patients in groups 2, 3, and 4 are treated by radiation alone, as described in a subsequent section

Our reasons for combining preoperative irradiation and surgery in preference to either irradiation or surgery alone for treatment of the local growth are First, when the patient is first seen the growth is active and for the most part the lymphatics are being invaded hence, postoperative recurrences are relatively high Secondly, irradiation destroys a large number of primary tumors or devitalizes the larger ones to the point where operative removal is safer and followed by less likelihood of recurrence Third, a high percentage of patients with cancer of the tongue still come in the inoperable stage The inoperability is either due to the extent of the local growth or of the metastases to the neck Many of these cases become operable following irradiation Fourth, radiation therapy given in sufficient quantities to eradicate squamous cell cancer in the mouth causes permanent tissue damage in the surrounding normal structures (obliterating endarteritis and sclerosis), resulting in a high percentage of secondary necrosis of soft parts and bone These secondary ulcers and bone necroses, occurring several months or years later (eight years in a recent patient) are exceedingly painful and incapacitating often causing marked weight loss from pain and starvation Removal of the irradiated site with a margin of healthy tissue obviates this distressing complication Fifth, excision of the irradiated site also removes lingering cancer cells (21 4 per cent in our series—Table 21), improving the patient's chances of recovery

Cancer of the floor of the mouth yields much better results with radiation than with primary surgical operation The margin of safety that can be given by surgery is small and many of these cases are extensive when first seen

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The technic of irradiation both by x ray and radium will be given in subsequent paragraphs Operations are usually performed from four to six weeks after completion of the series of irradiation treatments In some other clinics the operation is performed in ten days to two weeks after the completion of the irradiation therapy but we like to wait a longer time to allow more shrinkage of the growth and more devitalization of the cancer cells.

SURGERY

Cancer of the Tip of the Tongue Small well-circumscribed cancers of the tip of the tongue of the papillary type are excised with primary suture. Growths in the middle of the tongue a rare location, are of low histological grade, and are removed with a V incision giving a wide margin The sides of the V are brought together (Fig 256 A, B and C) leaving a good functional but shortened tongue Similar growths on the side of the tip are likewise excised through a V incision and the wound closed (Fig 257 A, B, and C) In these cases the normal side of the tongue is brought over to fill the defect caused by the excision of the growth, shortening the tongue These small wounds are closed with zero chromic catgut in the muscle and interrupted black silk approximates the mucous membrane edges These silk sutures are removed in seven days.

Hemiglossectomy Hemiglossectomy for cancer of the tongue has been practiced for many years. Rarely do we use hemiglossectomy alone for cancer of the tongue Many modern surgeons however perform hemiglossectomy associated with radical neck dissection on the affected side if there are palpable lymph nodes on the same side During the last two years, we have combined hemiglossectomy with radical neck dissection more or less as a routine in patients who will permit operation, even though the lymph nodes on the affected side are not palpable This, we feel warranted to do since one third of cancers of the tongue coming in without palpable nodes will sooner or later develop metastases in the neck (Morrow) The operation we have used will be described in detail in Chapter XIX on metastatic diseases of the neck This operation is performed in one of two ways (1) the composite operation in which the radical neck dissection is done and the mandible, floor of the mouth and half of the tongue are removed *en bloc* (3) An alternate method is the so-called *pull through* operation in which the radical neck dissection is done and the floor of the mouth and tongue muscles are loosened in the neck The neck wound is closed and the hemiglossectomy is done through the mouth and the resected neck tissues are pulled up through the mouth so that there is actually an *en bloc* dissection without removing the jaw In this paragraph we shall discuss only hemiglossectomy Within the past year this technique has been improved (Chapt. XIX)

Hemiglossectomy may be simple or may include the floor of the mouth In either case, the technics are similar except that when the floor of the mouth is included the resection is extended more deeply to remove mucous membrane and underlying muscle out to the mandible from the midline in the front to the junction of the anterior pillar and tongue posteriorly

Anesthesia is induced with pentothal sodium intravenously and an intratracheal tube for the administration of nitrous oxide and oxygen is passed preferably through the nose to be out of the way of the operator The pharynx is then packed off with gauze

Two stay sutures of medium black silk are inserted one on each side of the midline in the tip of the tongue (Fig 258 A-D) Butlin (1885) used this technic of placing stay sutures in the tip of the tongue in order to pull it out and guide the operator down the midline. It has been our practice for many years to outline the proposed line of incision with several stay sutures of medium black silk. A row is placed on either side of the line of proposed incision This is particularly advantageous far back in the mouth for if any bleeding should occur or if the tissues should retract into the pharynx, they can be retrieved easily by tension on the sutures. The electrosurgical cutting current (electrotome) is used the incision

assing down the midline of the tongue well way from the growth back to a point opposite he anterior pillar The incision then passes it right angles across to the pillar and edge of the tongue When the incision has been the anterior pillar There is little bleeding from the incision down the midline as there are few anastomotic vessels from side to side It is preferable to locate and ligate the lingual artery far back in the mouth unless this has been

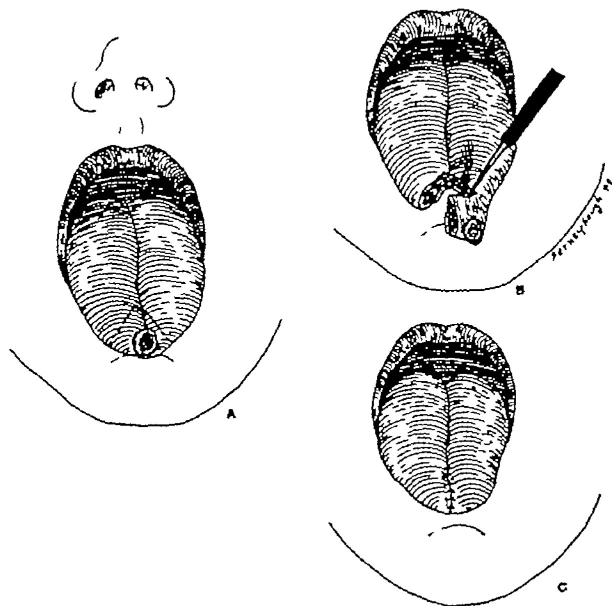


Fig. 256
A. Small squamous cell carcinoma at tip of tongue.
B Removed with V incision using electrotome
C Wound may be closed with black silk or chromic catgut sutures.

made half or two-thirds of the way down the tongue the operator then incises the mucous membrane beneath the tongue so that the tongue may be delivered farther out of the mouth The incision at the junction of the base of the tongue with the floor of the mouth passes back to meet the incision coming across the posterior part of the tongue at the line of previously ligated in the neck There is some bleeding from the incision across the posterior part of the tongue Bleeding vessels are clamped and coagulated by passing the coagulating current down the clamp

We usually let these wounds granulate in Some surgeons prefer to suture the mucous membrane of the dorsum of the tongue to the

floor of the mouth Following a simple glossectomy the scar gradually closes the wound and, if the floor of the mouth has not been removed, there is fairly good function both in swallowing and in phonation.

the mandible to the anterior pillar, so that the floor of the mouth containing sublingual salivary glands and sometimes the mylohyoid muscle is removed Here again it is well to place stay sutures for traction in the mucous mem-

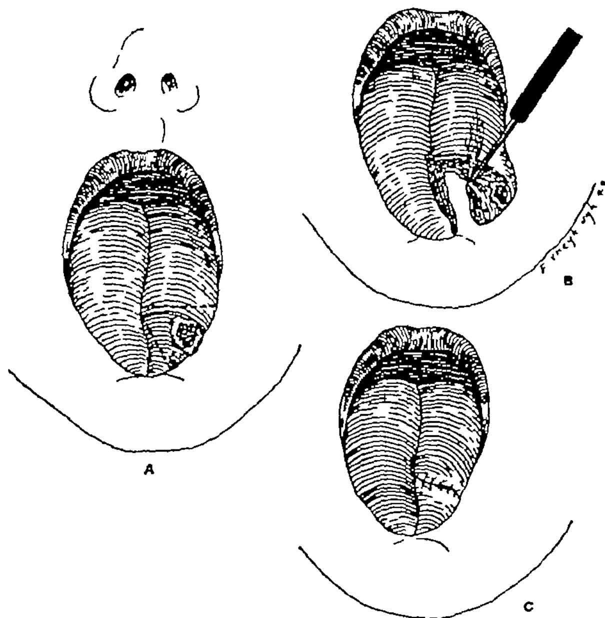


Fig. 257
A. Removal of a small carcinoma on the side of the tip of the tongue Incision shown by dotted line.
B Excised through a V incision with electrotome.
C Wound may be closed with black silk or chromic catgut sutures.

Hemiglossectomy including the floor of the mouth is performed in a similar manner to simple hemiglossectomy except that the incision in the floor of the mouth extends from beneath the tongue in the midline of the mouth to the midline of the mandible, and then around

brane to be removed. Bleeding points are controlled by coagulation through a clamp It seems to us that there is little difference in phonation and swallowing when the wound is allowed to cicatrize or when the mucous membrane edges are sutured immediately at opera

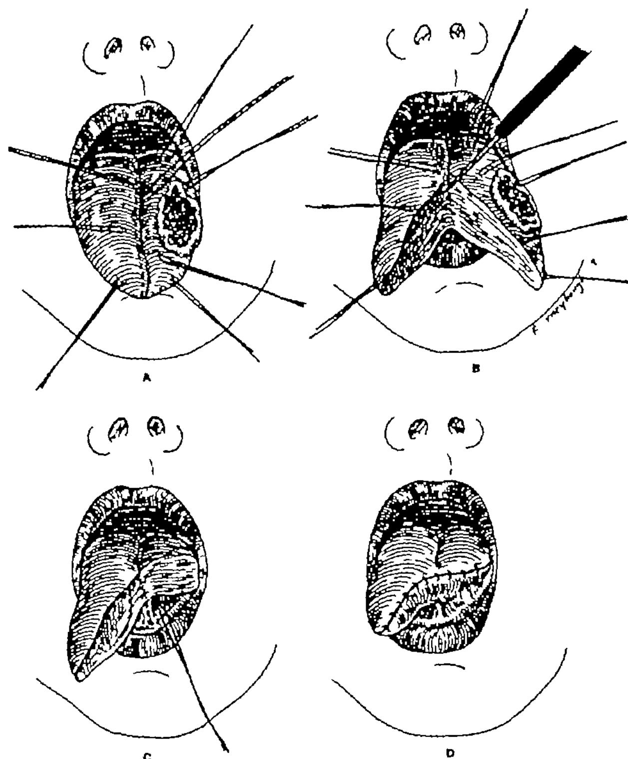


Fig 258. Technic of simple hemiglossectomy

A. Dotted line represents line of incision. Two stay sutures of medium black silk are placed, one on each side of the midline for traction Other stay sutures are distributed along each side of the line of incision Those on the side of the tumor serve as traction while removing the diseased area, obviating handling with forceps, a cumbersome and space-consuming maneuver in the mouth. The stay sutures beyond the line of incision serve to control at all times the remaining portion of the tongue of great assistance in stopping hemorrhage

B Incision with electrotome.

C Dotted line in floor of mouth represents extension of the incision in case the floor of the mouth is to be removed along with the primary lesion

D Closure of wound with black silk or fine chromic catgut interrupted sutures. This is not always possible when the floor of the mouth is removed along with hemiglossectomy

tion An exception is due to the cicatrization of *the tongue to the mandible* when the mucosa overlying the lingual side of the jaw has been removed

When the operation is not a complete hemi glossectomy some surgeons prefer to use the normal side of the tongue particularly the tip to suture over and close the raw surface Theoretically this is of value in closing the wound per primum However it has been our experience that function of the tongue is not nearly as good after curling the tip around to close the raw surface as it is when the tongue is converted into a long narrow organ either by cicatrization or by sewing the mucous membrane of the dorsum to the mucous membrane of the floor of the mouth.

Electrosurgery

Circumvallation. The technic of throwing a line of coagulated tissue around the carcinoma was described by William L Clark (1926) He used a biterminal coagulating current on a needle coagulator An indifferent electrode was *in contact with the skin at a distance from the* operative field The needle coagulator is plunged into the tissues a centimeter or more from the edge *of the tumor and allowed to* remain until a white ring of coagulation appears. The coagulation is then moved from place to place and the treatment similarly applied until a zone of coagulated tissue is developed around the growth, preventing lymphatic drainage from the diseased area. The tumor is then excised with scissors or knife through the coagulated area. Bleeding from uncoagulated blood vessels is stopped by direct application of a ball coagulator

Electrosurgical Excision. Newer electrosurgical instruments generating cutting currents capable of coagulating tissue on each side of the incision for a millimeter or two in depth replaces this two-step procedure by a single step In other words, with a flat blade-like electrotome the coagulation and excision of the tumor is carried out simultaneously Here again the growth to be removed is *outlined* by a double row of medium black silk stay sutures and the incision made between the rows of sutures. The row of sutures next to the growth is used for traction of the sutures out side the line of incision to regulate the edge of the wound The electrotome is passed through the tissues rather slowly allowing time for coagulation of lymphatics and small blood vessels.

We use a strong electrosurgical cutting current for practically all operations on the tongue and floor of the mouth Hemorrhage is controlled and the wounds are sterilized by the heat of the *current Some sloughing follows but* is of little consequence and is compensated by the sealing of lymphatics and blood vessels during the operative procedure.

Surgical Treatment of Metastases of Cancer from the Tongue to the Neck

To prevent repetition the combined surgical treatment of cancer of the tongue and metastases to the neck is discussed in Chapter XIX dealing with metastatic lesions of the neck

Medical literature contains many lists of indications for neck dissections in cancer of the face and oral cavity During the past three years, *we have adopted a rather radical atti* tude toward cancer of the tongue and floor of the mouth because of the seriousness of the disease. *It seems to be generally accepted by* most authorities that neck dissection is in dicated when there are palpable nodes in the neck and the primary carcinoma has been eradicated or there is reasonable assurance that it can be destroyed with irradiation or removed surgically Radiation therapy rarely gives a five year salvage when there are metastases in the neck from the cancer of the tongue or floor of the mouth The few controlled cases recorded like our own, had one or two solitary nodes heavily irradiated by x ray through a small cone followed by implantation of radon seeds or radium element needles. In a large series of cases of cancer of the tongue reported by Martin and Sugarbaker (1940) 35 per cent came in *with metastases, and 25 per cent* metastasized after admission The total num

ber of patients who developed metastases was 60 per cent. There were no metastases in 40 per cent of cases.

In 1939 Roux Berger and Tialhefer (1939), of Paris, reviewed 494 cases of carcinoma of the mobile part of the tongue, with special reference to treatment of the involved nodes In eighteen bilateral neck dissections in the absence of palpable nodes were done, and in all eighteen carcinoma was found microscopically Morrow (1939) reports that one-third of his cases without palpable nodes showed carcinoma in such material

With the improvement in anesthesia pre and postoperative care, including antibiotics proper nutrition and blood from a blood bank the mortality from radical neck dissection is low We hold that it is advisable to do a radical neck dissection even though the lymph nodes in the neck are not palpable on admission hoping to salvage as many patients as possible Another argument in favor of this decision is the analogy of the surgical treatment of breast cancer Halsted established, over fifty years ago (Johns Hopkins Hospital Reports, Balti more 1894–95 IV, 297–350) the importance of a radical operation for breast cancer in all cases where cancer was proved whether or not there were any enlarged nodes in the axilla By so doing the total five year salvage has been greatly increased Haagenson has recently re-emphasized the value of following the radical Halstedian principle and reports a high percentage of five year salvage (90 per cent) when the lymph nodes were not involved microscopically or grossly (1949) It is interesting to note that Fitzwilliams states that 40 per cent of the recurrences following operations on the tongue are found in the floor of the mouth

Carrying out the Halstedian principle of resection in continuity Ward and Robben (in press) devised the composite and pull-through operations to include in one dissection the lymph node-bearing fascia of the neck the floor of the mouth and half of the tongue with or without the mandible. Our first operation of the composite type was successfully carried out by Ward on February 15 1932 at the University of Maryland Hospital for a cancer of the alveolus of the left lower jaw (see Chapt XIX) A radical neck dissection was first done and the neck skin flaps sutured back in place before entering the mouth, reducing contamination of the neck to a minimum. The floor of the mouth and jaw were resected with electrosurgery The patient was followed for three years without recurrence and in good health.

Whether one of these more radical procedures or the time honored radical neck dissection is to be chosen the following indications for the neck dissection are

1 That the primary growth either has been eradicated or that there is reasonable assurance it will be removed at the time of the neck dissection In most of our cases, the patient had received preoperative irradiation with marked reduction or complete healing of the primary lesion Since there may be recurrences, we prefer that the primary site be removed surgically to reduce the possibility of recurrence and, second to avoid the radionecrosis which follows in a high percentage of cases

2 As stated above as a rule we no longer wait for palpable nodes to develop provided the patient is in good health and will submit to the radical procedure Many authorities insist upon the metastatic cancer being palpably demonstrable in the neck before a radical neck dissection In Chapter VI, it has been pointed out that 14 per cent of the patients without palpable nodes showed metastatic involvement of the nodes upon neck dissection Lip cancer is not as vicious as tongue cancer

3 The primary neoplasm should be limited to one side of the tongue or floor of the mouth If the primary growth encroaches upon the midline bilateral metastases are apt to occur From time to time a few cases have been operated on in our clinics and others have been reported in the literature on whom a bilateral neck dissection was performed in two stages. The nodes on the side of the involvement are resected first several weeks later a second operation on the opposite side is carried out Bilateral neck dissection is not a routine procedure and only used in selected cases having

midline cancer with small nodes limited to the upper neck.

4 The metastases should not be extensive should be movable and not below the omohyoid muscle We have successfully removed with electrosurgery some upper neck metastatic masses fixed to the floor of the mouth and jaw and occasionally to the deeper muscles of the upper neck. Adherence to the carotid arteries is practically always a contraindication to operation.

5 The patient's general condition is evaluated to determine his ability to withstand such an operation Age is not always a factor It is physiological age and not calendar age that is important

6 Distant metastases are contraindications to radical neck dissection.

Radiation Therapy to Anterior Two-thirds of Tongue and Floor of Mouth

Radium and x ray therapy have been used for carcinoma of the tongue for the last thirty five or forty years with varying results Experience improvement in technic and x ray generating apparatuses, together with increasing doses of both x ray and radium have improved results Also with larger doses complications have multiplied *Carcinomas of the anterior two-thirds of the tongue are, for the most part rather highly differentiated* and therefore histologically radioresistant The smaller percentage of anaplastic tumors are histologically radiosensitive Actually the same maximum dosage in all cases is used irrespective of histological characteristics The accessibility of the anterior two-thirds of the tongue to adequate radiation greatly offsets the radioresistance of many cancers. In other words, radiosensitivity and radioresistance does not parallel radiocurability or radioincurability

We now prefer X ray therapy to radium for treatment of the primary lesion as a preoperative measure for the following reasons (1) The x ray beam is of more uniform intensity than the radiations from radium applications. (2) Intraoral x ray cones permit accurate broken dose treatment (3) *Implantations of radium* element needles or radon seeds often excite infection and secondary slough Radon seeds are occasionally implanted as a supplement to x ray therapy especially when the growth is located far back in the mouth where it is difficult to obtain an accurate and sufficient x ray dosage

Lethal doses of irradiation (6000 r or gamma r to the tumor) causes tissue changes obliterating *endarteritis*, and sclerosis in the normal surrounding structures. These two processes go on indefinitely *The mouth is the seat of constant infection*, frequently initiating radionecrosis. A cold or sore throat often precipitates an ulcer in the indolent and avascular scar The removal of an infected tooth likewise starts radio-osteonecrosis, eventually resulting in the loss of the mandible or part of the maxilla. To reduce local complications to a minimum, protective shields and special applicators are used

Radon seeds or *radium element needles* inserted into the tongue require a properly fitting lead mold to protect the normal tongue and fit down between it and the mandible also shielding the maxilla above These lead filters are worn for the duration of the application of radium element needles or for six to ten days following radon seed implantation. Many authors have described various types of lead shields for protective purposes (Ackerman 1940 Spencer and Cade 1931)

When expedient *radium tubes* are held in the mouth directly against or at a 2 mm distance from, the tongue or floor of mouth cancer by a specially constructed apparatus containing lead protecting the normal surrounding structures. Such an applicator may be made out of dental compound and molded to fit the lesion and surrounding structures On the surface of the dental mold in contact with the tumor radium tubes are imbedded On the top of the compound mold sheet lead 3 or 4 mm thick is fastened James F Pyott (1942) devised a leaded resinous applicator for intraoral and extraoral radium therapy in which a small radium chamber is built The

chamber is made of lead on all sides except the one directly opposing the lesion where there is a window of acrylic resin (Chapt VIII) Permanency is an advantage of this particular applicator, permitting use on successive occasions to apply the radium accurately over the lesion Treatments are given in broken doses for two or three weeks, a type of Coutard method of radiation, if you please.

Radium element needles are inserted throughout the tumor and a surrounding zone of normal tissue at least 1 cm wide. The needles are placed 1 cm apart Each needle has a radioactive length of 2 cm and contains 2 mg of radium element, i.e. 1 mg per cm of length When treating tumors 1 cm thick, the needles are implanted beneath the base Tumors over 1 cm thick require two or more layers of needles, each layer being 1 cm from the other layer That is, all needles of this given length and strength are spaced 1 cm apart in all directions to give uniformity of radiant energy throughout the diseased area A total dose of about 5000–6000 gamma r is necessary to eradicate 78 6 per cent squamous carcinoma of the tongue (Table 21) Larger doses might eradicate a higher per cent of the cancers but would increase the complications.

For *interstitial radiation* with radon seeds we employ platinum iridium capsules, $\frac{1}{10}$ mm wall and find that a strength of 3 mc. per seed seems to be most practical for the larger number of cases. The seeds are distributed equally throughout the growth being sure to include in the treated area a good margin of healthy tissue (Fig 259 and Fig 260) The seeds are spaced 1–1.5 cm apart and the dosage calculated according to charts prepared by Edith Quimby (Table 1)

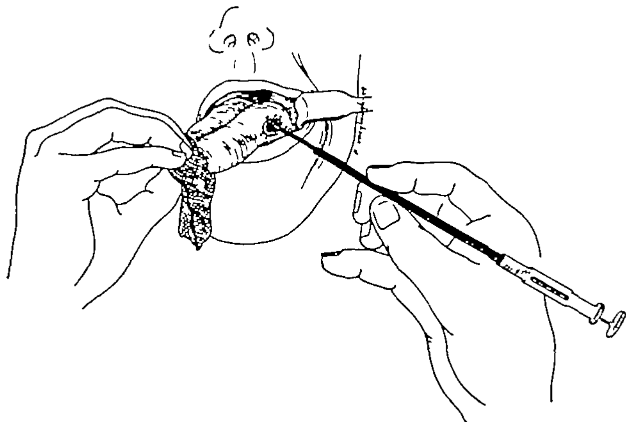


Fig 259 Technic of implantation of radon seeds or radium element needles into carcinoma of the anterior two-thirds of the tongue. Note seeds have first been implanted in the normal tissue at the edges of the growth. In the illustration the implanter is now being inserted into the main body of the tumor (Diagrammatic.)

Other dosage charts have been prepared by Laurence (1936 and 1937) and Patterson and Parker

Jorstad and Verda (1944) state that radium emanation in the form of gold radon implants

has been the most satisfactory type of treatment for cancer of the tongue During the previous five year period the authors have not excised any portion of the tongue for the cure of cancer

Under inhalation anesthesia or intravenous pentothal sodium they implant 1.5 mc. seeds, *1 cm apart surrounding and into the lesion* if necessary to give an average dose of 200 mc. hr destroyed per cc. of tissue Of fifty *five cases treated in the* Barnard Free Skin and Cancer Hospital, St. Louis, and thirty cases in a private series 64 per cent and 90 per cent, respectively showed no evidence of local recurrence or complete regression of the carcinoma in the tongue Surgical resection of the lymph-bearing tissue is their treatment of *choice in controlling metastases.*

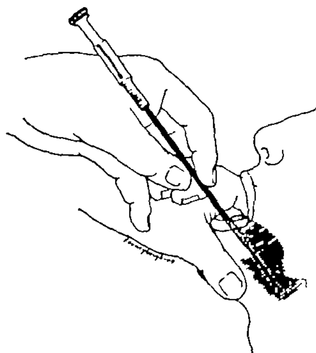


Fig. 260. Technic of implantation of radon seeds in carcinoma of the base of the tongue. Either under local or general anesthesia, the finger is inserted over the tongue to the vallecula. The implanter reaches the base of the tongue by passing through the floor of the mouth under the anterior part of the tongue

It should be mentioned that if radon or radium element needles are used in association with x ray therapy the doses of each added together should aggregate not less than 5000 r in the tumor and preferably 6000 r

Melville (1940) reporting from the Christy Hospital and Holt Radium Institute Manchester England, described the double radium mold for treatment of carcinoma of the floor of the mouth and lower alveolus Two molds are made one to fit inside the mouth over the lesion and the other to fit outside the mouth *around the lower* jaw The radium is so situated that it lies below the jaw and floor of the mouth The whole floor of the mouth anteriorly and the alveolus therefore get radiation from both sides simultaneously By this treatment the tumor receives from 8500–10 000 r In reporting on ninety-six cases treated by this method *Melville* states that 47 per cent were well three years after treatment and 35 per cent were well five years after treatment In stages I and II earlier cases five year salvage was 50 per cent and 33 per cent, respectively In stage III the five year salvage was 44 per cent. The average *healing time was four and a half months*, ranging from one to ten months.

X-ray Therapy The destructive effects and moderate penetration of low voltage or intermittent voltage therapy (100–140 Kv) can be effectively used for the destruction of cancer of the tongue and floor of the mouth when *delivered through a sterilizable lead cone* varying in size from *2–5* cm. in diameter Such x rays are applied without filter or with 1 mm Al and ½ mm Cu. depending upon the depth of infiltration of the tumor itself These cones are actually cylinders with lead walls so that the surrounding tissues are not damaged. The usual distance is from 20–50 cm

Our technic for cancer of the tongue and floor of the mouth is as follows

As a preparation for the treatment the teeth on the adjacent jaw are removed before treatment is begun or within the first few days thereafter greatly reducing the danger of radio-osteonecrosis at a later date Teeth in the front of the jaw are extracted if they interfere with accurate application of the cone. Infected carious, or ragged teeth anywhere in the mouth are removed *to improve oral hygiene, hasten* convalescence and obviate later extractions

which may initiate radio-osteonecrosis Treatment factors are 140 Kv, 15 Ma, no filter TSD 35 cm From 400-500 r are given three times a week so that the total dose of 5500-6000 r is given within three weeks time This dose suffices to destroy most cancers of 2 or 3 cm. in diameter or less Larger ones may require the addition of radon seed implantation to bring the total intratumoral dose to the desired amount in posterior areas.

Coupled with intraoral radiation we may use more penetrating x ray therapy through the skin If the tumor is in the anterior part of the floor of the mouth or tongue, a submental portal of suitable size is employed When the growth is farther back, one portal on the affected side through the mandibular area will add to the intratumoral dose A similar portal is added to the opposite side for the treatment of midline tumors The portal includes the suprahyoid triangle usually about 6 x 8 cm. Treatment factors are 200 Kv, 15 Ma, ½ mm Cu 1 mm. Al filter and 200 r are given at each sitting three times a week for ten applications or until the total dose is 2000 r in air

A discussion of the treatment of metastatic lymph nodes is given in Chapter XIX. Treatment of cancer of the posterior third (base) of the tongue will be found in Chapter XII

PROGNOSIS AND RESULTS OF TREATMENT

Although there have been many improvements in technic of irradiation and surgery cancer of the tongue caused 1115 deaths in the United States in 1938 (Vital Statistics Special Reports Bureau of the Census, Vol. 9 No 25 p 173 March 1940) As with cancer elsewhere in the body, the earlier the diagnosis, the better the prognosis Sharp and Spicker man found that 66 per cent of patients with tongue cancer who had symptoms less than 2 months were living after five years. When the symptoms had been present for from two months to one year the five year salvage dropped to 16 6 per cent Also when grouped according to size these authors found the following results in their 81 cases.

CASES GROUPED ACCORDING TO STAGES—WITH CORRESPONDING 5 YEAR STATISTICS
TOTAL 81 CASES

STAGES	NO. CASES	% OF TOTAL NO. CASES	NO. 5 YR. CURES	% OF 5 YR. CURES
I. Primary growth less than 1.5 cm. dia.	9	11 1	5	55 5
II. Primary growth less than 3 cm. dia.	14	17 3	7	50 0
III. Primary growth of indeterminate size with unilateral operable cervical nodes	30	37 0	7	23 3
IV Primary growth with invasion of surrounding structures and inoperable cervical metastases	28	34 6	1	3 6

Their method of treatment of the primary lesion was by irradiation alone Intracavity cones were used perorally and external fields of irradiation were employed as a supplement. Daily doses of 400 r measured in air, operated at 200 Kv and 15 Ma, using a filter of 2 mm. Cu The total was about 4800 r Radium needles were implanted on the last day of x ray therapy, giving 800 to 1600 mg hr Healing occurred in 41 7 per cent of the series Metastatic nodes were treated with preoperative x ray therapy, giving a total of about 4000 r to several ports Radical neck dissection was then done Forty four of eighty-one patients had metastatic lymph nodes on admission and gave a five year salvage of 15 9 per cent Nine patients developed metastatic lymph nodes during the course of disease with a five year salvage of 11 1 per cent In twenty-eight patients who did not have metastases at any time the five year salvage was 42.9 per cent These authors over-all five year salvage in the determinate group was 31.3 per cent

The over-all five year salvage as reported by several authors is about 25 per cent Martin and his co-workers report a five year salvage in the "operable group of 57 per cent "borderline" 36 per cent and in the inoperable group 7 per cent. Stanford Cade (1933) reports

a series of 255 cases of tongue cancer treated from 1925 to 1932 with a survival of 33 per cent, with 18 7 per cent living five to six years after radiation, and 11 per cent living for seven years His treatment was given with massive external radiation doses with a bomb containing from 2–6 gm. of radium element Harold Wookey of Toronto, reports that in 54 per cent of cancer of the tongue the disease was controlled by radiological methods He goes on to say, Surgical dissections offer the best hope of controlling the disease in the neck and should be done early One is inclined to believe that in cancer of the tongue dissections of the regional lymph masses might wisely be done before any enlargement of the glands can be demonstrated ' George Crile (1931) reports on 549 cases of carcinoma of the buccal surfaces of the jaw Twenty-one and three tenths per cent were carcinomas of the tongue 43.3 per cent were carcinomas of the lip, and 13.3 per cent were carcinomas of the jaw Of the cases having sufficient follow up data he found that 27.37 per cent lived for five years or more Elis G E Berven (1937) of Stockholm, reports on 457 cases of cancer of the oral cavity treated between 1916 and 1930 One hundred fourteen or 25 per cent were symptom free for more than five years. Of these cases 186 were cancer of the tongue with a five-year salvage of 26.3 per cent

Gordon B New (1935) reports a total of 37.2 per cent of epitheliomas of the tongue living five years or more New breaks down his figures as follows

Nodes not involved but dissected, 58 patients traced, with a five year salvage of 50 per cent.

Nodes not involved clinically and not dissected because of type of growth age of patient etc. 36 patients with a five year salvage of 52.8 per cent

Nodes involved and dissected 56 patients with a five year salvage of 14.3 per cent (cases in which there was extension in the floor of the mouth are not included)

Extension to the floor of the mouth, 6 patients traced 33.3 per cent five year salvage

The Texas Cancer Bulletin 1948 No I states that when lymph nodes are involved the five year survival rate drops from 40 per cent to 10 per cent

Pfahler and Vastine studied 186 cases of cancer of the tongue treated since 1904 excluding the cases which could not be traced 32 4 per cent of the patients were living and well three years after treatment, and counting the untraced cases as deaths had an absolute three year curability of 29.3 per cent This included 89 cases with palpable nodes, of which 17.8 per cent have been well for periods varying from 1½ to 9 years. All of their cases were treated with irradiation Radium was used by implantation in the mouth and radium pack was used externally to control the metastases in the nodes Their intraoral doses ran from 1500–3000 mg hr Their external irradiation was given with radium element filtered through at least 3 mm. of brass, but better, 2 mm of Pl or its equivalent at a distance of 4 or 5 cm. A total of from 30,000–60,000 mg hrs. was given in from three to four weeks. This external irradiation is to be compared now with that given by x ray therapy which is technically easier and requires much less time of the patient

Brown and Haffner (1939) made an excellent study and give a bibliography of fifty-one articles. In the beginning of their paper, they state that "radical operative removal of the tongue for carcinoma is seldom done at the present time, but it is interesting to note that a large number of authors recommend the dissection of the cervical lymphatics if there is any promise of a local cure with radium or local operation. (22 articles of 26 reviews) Such uniformity of opinion points to the conclusion at least for the present that dissection should be practically always done on the side of the involvement and that close watch should be kept on the opposite side so that it can be done there too at the first suspicion of metastasis.

Lawrence and Brezina (1945) report a survey of 29 carcinomas of the anterior tongue from the Department of Surgery of Yale University

from 1930-1940 The local lesion was treated by intraoral cone x ray therapy as well as multiple external fields or with x ray in combination with radium or radon seeds giving a total of 5000 r or more to the growth Only one patient who had a malignant papilloma of the tongue was treated by surgery alone Thirteen patients had lymph node involvement from a malignant lesion on the anterior tongue and only two survived the five year period whereas, three of the nine without node involvement were living and well at the end of the same period The outstanding cause of failure is the inability to control the disease once it has extended into the regional lymph nodes. Of twenty two cases so treated seven, or 32 per cent, were alive and well three years, and five or 23 per cent were alive and well five years. The primary lesion was controlled in seven or 32 per cent and not controlled in fifteen or 68 per cent. There was cervical lymph node involvement in thirteen, or 59 per cent

Nuttall (1943) reports on 442 patients suffering from cancer of the mouth all treated with radium with various technics The technics included radium plaques, implantation of needles and radon seeds, and the double so-called *sandwich mold* described by Melville in 1940 In those cases of carcinoma of the tongue remaining node-free, 70 per cent were well after five years.

Paterson (1941) gives the following results of treatment of cancer of the tongue and floor of the mouth with radiation alone

The five year survival rate of carcinoma of the tongue without lymph node involvement is 70 per cent and of the floor of the mouth without lymph node involvement, is 61 per cent. These patients all remained node-free, or died as a result of failure of the primary treatment Patterson states that this shows that cancer within the mouth is essentially a curable disease particularly when treated in the early stages Cases with lymph node involvement had radical neck dissection In an analysis of 142 cases of all types of mouth cancer including fauces and base of the tongue there was a net percentage alive at the end of five years of 35 per cent In the group with lymph node metastases proved by microscopic examination the net five year salvage was 36 per cent Patterson did not include in this series those cases in which death was due to a recurrent primary lesion, although the nodes remained apparently free

Berven (1937) by a method of cross-firing from several external portals combined with internal application of radium either by interstitial implantation or in the form of radium tube applicators, was able to deliver 5100 r to the floor of the mouth. Berven reports that during different periods, that is, 1916-21 1922-26 1927-28, 1929-30, etc. they treated 54 50, 37 and 45 cases of tongue cancer and obtained a five-year cure of 32 32, 19 and 20 per cent, respectively The cases were grouped in this manner because of the improvement in radiation technic during the years. He states

In spite of improved methods of treatment and increased experience, there has thus far been no improvement in the five year cures In one group, that of lingual cancer even a lower five year cure has been obtained, a fall from 32 per cent during the early period to about 20 per cent in the later ones. In my opinion the explanation lies in the greater seriousness of the more recent cases. He goes on to state that more extensive cases were sent to him as the years went by because referring physicians felt that there was some value of radiation therapy in palliating even the late cases

During the same period, they treated 11 21, 5, and 3 cases of cancer of the sublingual region, and obtained a five-year cure of 46 29 20, and 67 per cent respectively The variation in the percentage is due to the small number of cases in this group

This was ten years ago Because both radiation therapy and surgery then as now still leave much to be desired in the treatment of primary lesions in cancer of the tongue as well as in the cervical metastases we undertook, three years ago to combine heavy local irradiation therapy to the primary growth and ex

TABLE 21

CARCINOMA TONGUE AND FLOOR OF MOUTH

Preoperative Radiation

SEX	INITIALS	NO.	PRE RAD. BIOPSY	PRE RAD NODES	SIZE AND LOCATION	RADIATION					OPERATION		
						Date	Intraoral	External	Interstitial	Tumor Dose	Date	Type	Operative Specimen
M	J M	GFW 6822	Squam. cell	None	Left side post. third 1.5 cm.	2/3 3/5 1947	4760 r	2100 r left submax		5273 r	May 1947	Composite	Positive for malignancy in primary and nodes
F	O A	GFW 6831	Squam. cell	None	Rt side mid. third 1.5 cm.	2/3 3/5 1947	4896 r	2100 r right submax		5430 r	5/8/47	Pullthrough	No malig. in primary or nodes.
						5/22 Dec 47		Rt. neck 1200 x 2			10/18 1947	Sequestrectomy	Jaw
						2/6 4 1948			right neck 33 mc		1/8/49	Resection rt. mandible	Large hard mass angle jaw not biopsied—well 1 yr to date after radiation
M	W B	CEW 7000	Squam cell	None	Rt. side post third 2 cm	4/21 5/23 1947	5440 r	Rt. jaw & cerv 2100 r		5849 r	7/11 1947	Pullthrough	No malig. in primary or nodes
F	E.D	CFW 6086	Squam. cell	?	Rt floor mouth 1 cm.	12/21 1/28 45–46	4480 r	Bilat. cerv 1400 r		4723 r	2/21 1946	Composite	No malig. in primary or nodes
M	J F L	GFW 7027	Squam cell	None	Rt. tongue & floor mouth 3 x 1 cm. recurrence	5/5 1947			30 mc	4955 r	8/46 1947	Composite	No malig. in primary or nodes
						7/9 1947		Rt. submax. 2000 r					

M	J H	GEW 7085	Squam. cell	Left sub-max.	Left floor mouth 2 x 3 cm.	5/23 6/20 1947	5440 r	2800 r sub-men-tal		6051 r	9/21 1947	Pullthrough	No malig. in primary or nodes
M	J R.Y	GEW 7265	Squam. cell	Left sub-max.	Left post. 3d 1.5 cm. Tongue	11/17 12/3 1947		Left neck & jaw 2200 r	10/17/47 12 mc	3582 r +	3/3 1948	Pullthrough	Malig. primary Nodes neg.
M	J L.	GEW 7027	Squam. cell	? Rt. sub-max.	Rt. tongue 1.5 x 2 cm.	11/28 1/2 47–48	5440 r	Rt. neck 1800 r		5852 r	11/3 1948	Pullthrough	No malignancy in primary or nodes
F	W M C.	GEW 7435	Squam. cell	Submen & rt. sub-max.	Rt. undersurf tongue 1.5 cm.	1/9 1/30 1948	2040 r & 4700 r	Rt. neck 2000 r			5/13 1948	Pullthrough	No malignancy in primary or nodes
M	M R.	GFW 7451	Squam. cell	—	Rt. tongue post. third 5 x 2 cm	1/14 2/16 1948	5440 r	Rt. submax 2100 r		6100 r	3/10 1948	Pullthrough	No malig. in primary or nodes
M	D C.M	GEW 7837	Squam cell	None	Rt. floor mouth 1.5 x 3.5 cm.	8/2 9/4 1948	5440 r	Rt. sub-max. 2100 r		6331 r	11/1 1948	Composite	No malig. in primary Nodes positive
M	J V	AGS 218	Squam cell	None	Left tongue middle third 4 mm. in extensive leukoplakia	12/8 1/9 1947–1948	5440 r	Left sub-max. 2100 r		5368 r	2/7 1948	Pullthrough	Positive malignancy in primary Neg. nodes.
F	D E.	GEW 5222	Squam. cell	Not stated	Left tongue floor of mouth 3½ x 2 cm.	5/1 6/9 1944	2225 r	5210 r		4876 r	3/2 1945	Hemiglossectomy	Negative for malignancy
M	W H.B	GEW 5369	Squam. cell	None	Left tongue floor of mouth mid. third 8 x 12	10/11 10/25 1944		5064 r	9/20 1944 12 mc	13,560 r	7/8 1945	Excision & neck dissection & mandible	Negative for malignancy in primary and nodes

ternal irradiation to the nodes, followed in four to six weeks by radical neck dissection and resection of the primary growth in continuity * Further basis for our radical operation was the principle of dissection in continuity laid down by Dr Halsted in his radical breast operation over fifty years ago

The following Table 21 prepared by A G Siwinski, collaborator in the study shows that 78 6 per cent of the primary sites were negative for cancer after radiation as demonstrated by special pathological study Serial sections were not done but the pathologists were asked to make many sections in search of persistent malignant cells.

The lowest tumor dose was 3582 r (Case No 7) and the highest was 13,560 r (Case No 14) Pathological examination of case No 7 showed questionable remaining malignancy Case No 1 had very extensive involvement on admission and died in the hospital postoperatively of pulmonary tuberculosis and with recurrence of the cancer Case No. 2 was complicated by radio-osteonecrosis of the mandible, requiring resection. Her neck dissection was limited to the submaxillary triangle. A large round mass, 3 or 4 cm in diameter appeared in the region of the superior deep cervical node. No biopsy was taken on account of associated infection but the mass has disappeared following the implantation of 33 mc. of radon. Patient is free of demonstrable disease to date (1 yr)

Case No 12 had extensive involvement at time of admission and eradication was unlikely He died of carcinoma Except for cases Nos. 1 and 12 all are alive and well to date

DISTANT METASTASES

The late George Crile (1931) stated that F W Hitchings made a study for him of 4500 reported cases of head and neck cancer and found less than one per cent had secondary foci in distant organs and tissues. Martin Munster and Sugarbaker state that in autopsy records of the Memorial Hospital it has been found that of about 68 patients dead of lingual cancer 12 (18 per cent) had visceral metastases with distribution as follows

Lungs 7 liver 4 mediastinal nodes 4 pericardium 4 pleura 4 diaphragm 2 ribs and sternum 1, humerus 1

They also state that visceral metastases are particularly likely to follow growths of the base of the tongue where anaplastic tumors are common Spencer and Cade discuss at some length the dissemination of cancer of the tongue and mouth to the viscera They report a number of interesting cases from the literature and of their own These included metastases to the right and left ventricles of the heart lungs and bronchial nodes, pleura, apex of the lung, liver heart, and diaphragm, the kidneys and the adrenals all in one case reported by Godlee. These authors likewise refer to an interesting specimen in the Royal College of Surgeons Museum (No 2108 1) showing a vertical section of the upper end of the right femur The extremity of the shaft was destroyed by growth shown microscopically to be a squamous cell carcinoma which was secondary to a tumor of the tongue Their own four cases showed metastases in the lungs, skin on the left side of the neck and over the right shoulder liver subcutaneous deposits in the skin of the chest and in the atlas and axis.

OTHER MALIGNANT TUMORS

There are several other malignant tumors of the tongue which although rare, should be mentioned for the sake of completeness.

Lympho-epithelioma. These tumors are not common in the tongue and a diagnosis is made by biopsy Elsewhere in this volume (Chapt. XVIII) detailed treatment of lympho-epithelioma is given The treatment in cases of the tongue should be with external irradiation and implantation locally if necessary Inasmuch however as metastasis occurs early the outlook is not good

Lymphosarcoma. These cases can usually be carried along for two or three years by roentgen irradiation through large fields, for they are

* Because of delayed postoperative healing we have discontinued radiation through the skin if operation is planned

relatively more radiosensitive than carcinoma. Further details of the treatment of lymphosarcoma are given elsewhere in this volume (Chapt XVIII) Jutras (1935) of Paris, reports sixteen cases out of forty-six in the oral cavity controlled five years by fractional external roentgen therapy Surgery is definitely not indicated

Sarcoma. The diagnosis, here again is made by biopsy Treatment is the same as for carcinoma. The radiosensitivity of the tumor should be estimated by biopsy but, in any case, might not be expected to be greater than moderately well-differentiated squamous cell carcinoma.

Adenocystic basal cell epithelioma is occasionally seen in the floor of the mouth or under surface of the tongue. Apparently these tumors take origin in the basal layer of the epithelium or in the mucous glands. They are comparable to the adenocystic basal cell epitheliomas seen in the skin, but are more malignant. They are not very sensitive to irradiation and frequently recur after surgery

Treatment should be of a radical surgical type as described for carcinoma, with or without preliminary irradiation Their prognosis is not good

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Chapter X

TUMORS OF THE JAWS

The embryology of the jaws is carefully outlined in Chapter II. It should be repeated here that the jaws arise as maxillary and mandibular processes of the first branchial arches forming respectively the upper and lower jaws. The jaws are bones covered with epithelium from the first branchial arches therefore, they are made up of both ectodermal and mesodermal tissues. Ectoderm and mesoderm both contribute to tooth germ development. Orban (1944) states, 'The ectoderm of the oral cavity forms the epithelial enamel organ which molds the shape of the entire tooth and gives rise to the enamel. The mesoderm differentiates into dental pulp inside the enamel organ and elaborates the dentin The mesoderm surrounding the enamel organ forms the cementum covering the root and the peridontal membrane.' It is evident, then that in discussing tumors of the jaws, one must include both ectodermal and mesodermal neoplasms We omit from this chapter tumors arising directly from the mucous membrane overlying the jaws which have been dealt with in Chapter VIII on malignant tumors of the oral mucous membrane, and limit jaw epithelial tumors in this treatise to those actually developing within the bone itself even though such epithelial tumors indirectly arise from the mucous membrane covering the jaw and are in reality mucous membrane appendage tumors. It might be said then that true jaw tumors may be divided into two main types—those springing from epithelium and those having origin from mesothelium (bone, connective tissue, and blood vessels) It has been the custom in the past to make three or more main divisions for example tumors of dental origin, tumors of epithelial origin tumors of osseous tissue and tumors of non-epithelial and non-osseous tissue.

It is helpful to remember that the primitive oral epithelium has the potentiality of developing six different adult structures namely squamous epithelium, mucous glands, dental buds, salivary tissue thyroid tissue, and Rathke's pouch of the hypophysis Because oral epithelium has the ability of developing so many different structures there occur in the head and neck particularly in the jaws, tumors of epithelial structure, simulating epithelium that is not normally present in a given site. The occurrence of these tumors in bizarre locations is explained on the basis of either embryonic rests or metaplasia. Cohnheim advanced the theory that these tumors occurring in an area where the type of tissue from which they spring does not normally occur are due to fragments of embryonic tissue which he termed *embryonic rests* being retained within the adult organ To quote William G MacCallum,

> "Cohnheim's idea was that at some stage of embryonic life cells might become isolated while still possessed of great energy of growth and potentialities, which would have carried them on to the development of some specific tissue of the body had they remained in their normal connection with the rest of the cells of the embryo. These cells are conceived of as lying dormant among the growing tissues and showing no tendency to unfold their own powers of growth during the years. Then, when the other tissues have become organs of an adult man and commonly late in the life of this man, the hidden group of cells, still endowed with embryonic vigor begins to grow Cohnheim did not think that these cells would begin their growth without some stimulant, but that once started they would exhibit a capacity for growth comparable only to that of the embryo."

Another theory for the occurrence of these tumors in a region where the type of tissue from which they spring does not normally occur is the theory of metaplasia based on a standard principle in embryology It is well

described in an article by Eugene R. Whitmore as follows

"All epithelial growth is from basal cells, differentiation taking place as the epithelium matures to the particular type normal for that area. In embryonal life, the epithelial cells have the potentiality to form different types of epithelium and, in the basal cells, these potentialities are not lost some of their potentialities have become recessive, while one of their potentialities has become dominant."

For example, the epithelium overlying the jaw has the power of developing dental buds Some of this epithelium passes up into the hypophysis as Rathke's pouch. For some unknown reason, one of the recessive characteristics of the cell namely to develop dental epithelium becomes dominant and an ameloblastoma appears in the hypophysis. Likewise, the epithelium overlying the jaws has the recessive characteristic to develop salivary tissue. For some unknown reason in adult life this recessive characteristic becomes dominant and a salivary gland tumor appears in the jaw In developing any classification of jaw tumors, these facts must be borne clearly in mind.

It is not our purpose in this chapter to indulge in a detailed discussion of the origin of tumors of the jaws, as this book is primarily of clinical value both diagnostically and therapeutically In dealing with each type of tumor however enough must be said by way of origin and histogenesis to aid in the diagnosis

CLASSIFICATION

Table 22 gives our classification of jaw tumors developed as a working basis for diagnosis and treatment. The two main divisions have to do with embryonic tissue origin, i.e from ectoderm and mesoderm. There are two minor divisions, one including mixed tumors made up of both ectodermal and mesodermal structures, and the other metastatic tumors. Tumors of the antrum may invade the upper jaw—these tumors are discussed in Chapter XIII

ROENTGENOLOGICAL CHARACTERISTICS OF TUMORS OF THE JAWS

Careful radiological study of jaw tumors over a period of years in which diagnosis has been checked by histological examination, has led us to the following conclusions which are helpful but not absolute in making a provisional diagnosis prior to biopsy or operation.

BENIGN TUMORS

It is not always possible to differentiate between a simple or multilocular cyst and a benign tumor As a rule, benign cysts and benign tumors show a radiolucent area or areas with regular outlines. The edge of the tumor is surrounded by a dense white line. Benign cysts and benign tumors may be single, multiple or multilocular

Benign tumors, when of sufficient size, expand the jaw thin the cortex or destroy it by pressure, but do not invade the cortex There is no periosteal reaction They are usually oval or circular in shape.

Osteofibroma may not have a definite border (ill-defined edge) but expands and thins the cortex without periosteal reaction

Benign cysts and tumors produce no definite soft tissue changes. In benign giant cell tumors, there are apt to be trabeculations. Trabeculations are not always present, particularly if the shadow is singular Trabeculations are also present in ameloblastoma fibrocystic disease and myxoma (See Figs. 306C 307B C) In Figures 312A, B the bone was so eroded by a tumor which had broken through the lingual side of the jaw that only small trabeculations could have formed Trabeculations in fibromyxoma are apt to be in the form of lines through the tumor instead of round compartments (Thoma)

POSITION OF TEETH

Benign cysts and benign tumors may appear at the apex or side of the teeth. If the crown of the tooth is in the radiolucent area the diagnosis may be dentigerous cyst although fibro-

osteomas and adamantinomas occasionally enclose the crown of a tooth in the radiolucent area. Involved areas may be more opaque when containing bone spicules Teeth may be displaced by pressure of a benign cyst or benign the root of a tooth actually hanging in the bone cavity resulting from malignant destruction of the surrounding osseous tissue Such malignant destruction may be caused by a central malignant neoplasm primary or meta

TABLE 22

CLASSIFICATION OF TUMORS AND CYSTS OF THE JAWS

Ectoderm (Primary Jaw)			
Congenital	Dental Epithelium	Oral Epithelium	Neural
Fissural cysts Nasoalveolar Median Globulomaxillary Nasopalatine Incisive canal Cysts of Papilla palatina	Odontogenic cyst Follicular (primordial) cysts Radicular (Cholesteatoma) Periodontal cysts Dentigerous cysts Odontogenic tumors Ameloblastoma Ameloblastic-epithelioma Enameloma Odontoma (epithelium only)	Adenocystic basal cell epithelioma Cylindroma Central carcinoma Dermoid cyst	Peripheral nerve tumors
Mixed Tumors (Ectoderm and Mesoderm)			
Salivary Tissue Tumors Odontoma—mixed			

Mesoderm (Primary Jaw)				
Traumatic	Osseous	Connective Tissue	Odontogenic	Giant Cell Tumor
Localized osteitis fibrosa with or without cysts Traumatic cysts	Benign Hyperostosis Exostosis Torus Palatinus Torus Mandibularis Osteoma Fibrous osteoma Chondroma & osteochondroma Giant cell tumors (osteoclasts) Malignant Osteogenic sarcoma various forms	Cementoma Dentinoma Fibroma—central Fibromyxoma Fibrosarcoma—central Angioma—central Endothelial myeloma (Ewing tumor) Multiple myeloma Granulomatous diseases	Soft odontomas Giant cell epulis (odontoclasts)	Endothelial type

Metastatic Tumors (Secondary Tumors)	
Ectoderm carcinomas	Mesoderm sarcomas

tumor the direction of displacement depending upon the relationship of the pathological process to the crown or root or neck of the tooth The root of a tooth may be destroyed by pressure of a benign tumor It is interesting that the root of a tooth is rarely destroyed by a malignant process Rather it is common to see static, or by an invading neoplasm from the adjacent tissues.

MALIGNANCY

Malignant invasion of the jaw usually gives an irregular motheaten appearance. ' Bones react to the growth of tumors in very much the

same way whether the *tumors are benign* or malignant primary or secondary This reaction is also independent of whether a skeletal tumor is soft or is bone-producing With rare exceptions the reaction of bones can be regarded as a combination of two principal changes The first is characterized by the resorption of bone tissue caused by growth of *the tumor the second is characterized by the* production of new bone, compensating for the loss of bone and developing mainly under functional stimuli (Weinmann and Sicher, 1947) Malignant tumors cause rapid resorption of bone allowing little time for new bone formation hence there are irregular areas of bone loss appearing as radiolucent spaces of varying size and shape. *The bone cavities may show* some opacity caused by the tumor tissue itself Occasionally there may be new bone spicules laid down or new bone may develop beneath the periosteum at the edge of the tumor (Codman)

Adamantinomas (ameloblastomas) represent more or less an intermediate stage between malignancy and benignancy *Since ameloblastoma* tends to hollow out small, more or less rounded areas in the bone, often a honeycomb or soap bubble appearance results. In two of our cases of adenocystic basal cell epithelioma (Fig. 281–282) the mandible appeared to have been shot through with buck-shot, representing true bone destruction

In malignancy *the bone destruction may* be central alveolar or peripheral. Central destruction occurs if the malignancy is primary in the central portion of the mandible, or metastatic from neoplasms elsewhere. Alveolar destruction is usually due to direct invasion from the adjacent mucous membrane, and peripheral destruction results from direct invasion from an attached neoplasm *along the lateral or lower* or medial border of the mandible. Should the neoplastic process be one in which new bone is produced (osteogenic sarcoma) a typical sun ray appearance may be observed This was also seen in one of our cases of anaplastic carcinoma arising apparently in odontogenic rests in the jaw of a boy seven years old (Fig 279D)

Periosteal reaction is slight or none (Ewing) Codman (1926) described the lifting of the periosteum at the edges of the growth as the "reactive triangle."

OSTEOMYELITIS

It should be remembered that osteomyelitis, as a rule, attacks the organic substances in bone. Inorganic salts are dissolved only to a small degree. Consequently a sequestrum may be formed Sequestra are not always present and only occur after the disease has progressed for considerable time. The loss of bony substance gives an *irregular motheaten appearance* in the roentgenogram not always distinguishable from malignancy particularly when the malignant process begins in the central part of the jaw (Fig 281)

Periosteal reaction may be present in osteomyelitis of the jaws as with osteomyelitis in other bones. In the roentgenogram new bone is seen laid down beneath the displaced periosteum. This type of periosteal reaction is seldom encountered in malignancy

ECTODERMAL TUMORS PRIMARY IN JAWS

Congenital Anomalies

FISSURAL CYSTS

In Chapter II on embryology attention was directed to the fact that retained epithelial *rests occasionally are found at the places of* fusion of the various embryonic processes which go to make up the jaws. These epithelial rests occasionally grow to form cysts which have been given the name of fissural cysts. These cysts are not common They are mentioned here largely for the sake of differential diagnosis. We have drawn freely from Thoma *(1944) for the following* discussion as these cysts are more commonly seen by the dental surgeon than the general surgeon

Nasoalveolar cysts. *Nasoalveolar cysts occur* in the anterior part of the nostril or wing of the nose and are associated with swelling of the upper lip These cysts result from epithelial cell rests of the facial cleft region and are lined

by epithelial cells overlying a connective tissue base. The contents of the cyst are often thick, whitish mucous fluid Thoma reports a case in which the fluid was brownish color According to this author roentgenological examination gives negative results as the bone is not invaded. There may be some pressure defect in the bone Treatment is operative removal.

Median cysts. Median cysts arise in the mid line of the maxilla or mandible. In the maxilla the cyst may be alveolar or palatine, depending on its location The alveolar median cyst forms between the roots of the first incisors. The teeth may be normal except the roots are pushed apart and the teeth are slanting. The median palatal cyst occurs in the posterior part of the palate and should not be confused with an incisive canal cyst which is more forward

Treatment is surgical removal of the cyst wall

Globulomaxillary cysts. These cysts form at the junction of the globular and maxillary processes and occur in the alveolar bone between the roots of the second incisor and canine teeth causing them to diverge. A globulomaxillary cyst may be mistaken for a radicular cyst but the latter do not start between the roots and do not change the position of the teeth The adjacent teeth are normal in the x ray film and are located on the labial or palatal side of the cyst.

Treatment is surgical removal of the cyst wall.

NASOPALATINE CYSTS

These cysts form in the incisive canal and may occur in the center of the bone when they are called incisive canal cysts, or under the papilla palatina in the incisive foramen when the name *cysts of the papilla palatina* is ascribed

Incisive canal cyst (cyst of the nasopalatine duct) This cyst arising from remnants of the embryonic nasopalatine duct, occurs in the midline of the upper jaw above the apices of the central incisor teeth (Fig 261 A, B) It is generally lined with squamous epithelium and contains a thin yellowish or brownish-white viscous fluid with debris. Roentgen examination shows a shadow connected with the incisor region of the maxilla and apt to be confused with radicular cysts. They are not connected with the teeth although the area of the

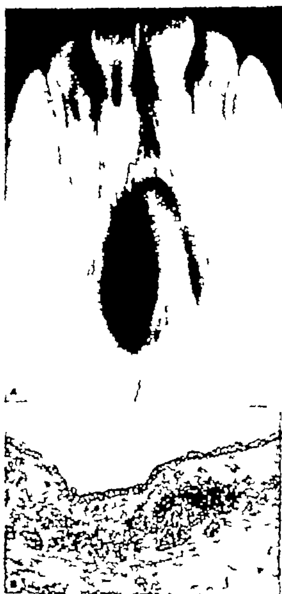


Fig. 261

A. Incisive canal cyst (cyst of the nasopalatine duct) Sometimes these cysts are called *median anterior maxillary cysts*

B Photomicrograph showing epithelial lining of cyst. (Courtesy Dr Myron F Aisenberg. Dept. of Pathology Balto. College of Dental Surgery Dental School Univ of Md.)

cyst may throw its shadow over the apices of the central incisor teeth. Treatment is operative removal of the cyst lining

Cysts of the papilla palatina. Thoma (1936) first described this type of cyst which forms from the epithelium of the incisive foramen,

rather than the incisive canal. It is not completely surrounded by bone and forms a rounded soft swelling in the neighborhood of the papilla palatina in the midline of the anterior palate It is fluctuant but does not give the parchment like sensation of a cyst that has thinned out the overlying bone as do large incisive canal and median cysts located deeper in the bone Mucofibrinous semi-liquid may be expressed from the outlets on the side of the papilla X rays are negative as the cyst does not expand the inside of the bone

Treatment is surgical excision through a U shaped flap of mucosa. The teeth are not disturbed

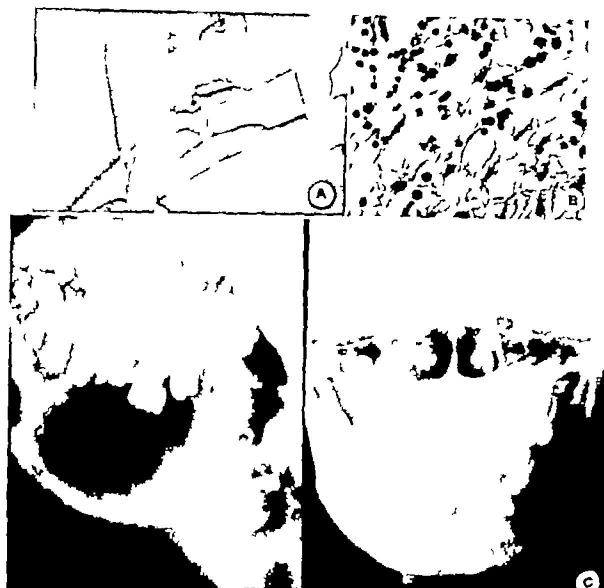


Fig 262

A Follicular cyst in the molar region of lower jaw
B Photomicrograph showing edematous inflammatory tissue from secondary infection
C X ray lateral and A P views Note there is no tooth contained in this cyst Teeth were extracted and cyst curetted previously

TUMORS OF DENTAL EPITHELIUM

In early embryonic life the jaws are formed by the maxillary and mandibular processes of the first branchial arches and are covered with ectoderm During development epithelial appendages grow down into the lower jaw or up into the upper jaw to form tooth buds (see Fig 269) These tooth buds produce the enamel

organ which forms the crown of the tooth, the root of the tooth arises from mesodermal tissue of the primitive jaw itself Various cysts and neoplasms arise from abnormal development of this submerged ectodermal dental epithelium. Cysts arising from dental epithelium are true cysts in that they are formed from epithelium and are lined by epithelium The cysts seen in localized osteitis fibrosa and traumatic cysts of the jaw may be lined by epithelium secondarily growing into the cyst through a fistulous tract True cysts arising from dental epithelium are called *odontogenic cysts* and are classified into four main groups follicular, radicular peridental and dentigerous.

ODONTOGENIC CYSTS

Follicular (primordial) cysts form during the developmental stage of the tooth and consequently occur in young patients. They remain symptomless until later in life The simple follicular cyst contains no teeth and is most commonly seen in the third molar region (Fig. 262 A, B and C) Often the first symptom is perforation and the formation of a fistula through which the contents of the cyst are discharged into the mouth, giving a disagreeable taste Since there are no teeth in the cyst, the normal complement of teeth will be present, a distinguishing characteristic from dentigerous cysts which contain the crown of the tooth. The first symptom to call attention to the presence of the cyst may be expansion of the jaw without pain. Paresthesia of the lip, due to pressure on the mandibular nerve, has been observed in other cases. In the roentgenogram, a radiolucent area is seen with well-defined, regular edges, with a characteristic white line caused by the cortical bone encapsulating it Treatment is incision and curettage of the cyst wall

Radicular cysts (*epithelialed granuloma*) Radicular cysts occur most commonly at the roots of the teeth thus differentiating them from follicular cysts and dentigerous cysts (Fig. 263 A and B) They may occur at the lateral surface of the root

Radicular cysts are thought to have origin in chronic infectious granulomas at the side or apex of the tooth As the granuloma liquifies, it may be changed into a cyst by extension into it of epithelial remnants from the sheath of Hertwig

Residual radicular cysts develop at any age and are found in edentulous parts of the jaws (Fig 264 A B) Thoma suggests that "When



Fig 263

A. Radicular cyst. This particular illustration shows a radicular cyst of the lateral type occurring at the side of the tooth.

B Section through the tooth showing the cyst in the tooth root. (Courtesy Dr Myron F Aisenberg. Ibid.)

they occur in edentulous jaws, the teeth either were extracted without recognizing the presence of a cyst or else a granuloma with or without root apex was retained to develop later into a radicular cyst." They occur in the maxilla, as well as in the mandible The cysts contain a thick mucous-like or watery thin fluid In most of those that we have seen the cyst was filled with chronic granulation tissue indicative either of a prolonged infection and



Fig 264 Radicular cyst of edentulous upper jaw 20 years after extraction of teeth. Symptoms of painful swelling of left upper alveolus.
A. A P view—note dome-shaped soft tissue swelling extending into antrum.
B Lateral view—shadow indicated by arrow

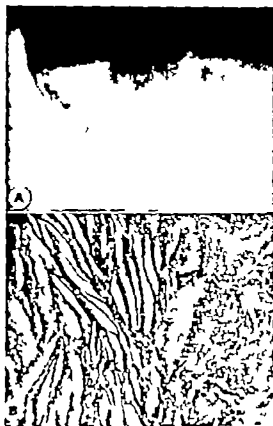


Fig 265
A. Radicular cyst (residual cyst) developing from dental epithelium left in the jaw after extraction of teeth.
B Photomicrograph. Open spaces in section are left from the dropping out of cholesterin crystals. (Courtesy Dr Myron I Aisenberg Ibid.)

fibrosis or fibrous tissue reaction after previous operation. Cholesterin crystals may become abundant due to tissue disintegration. Figure 265 A and B is a good example of a radicular cyst which was filled with cholesterin in an edentulous upper jaw

Roentgen examination shows a regular radiolucent area in the mandible or maxilla of varying size and located at the apices of the teeth (Fig 266) There is a characteristic white out line of the condensed cortical bone at the edge of the cyst In multiple cysts trabeculations may be seen and if the edge of the cyst is irregular and motheaten adamantinoma must be borne in mind.

Periodontal cysts may be either follicular or radicular in type The follicular cysts may develop on a partly erupted or retained tooth or from supernumerary tooth germs. The radicular periodontal cysts develop similarly to the radicular cyst already described The periodontal cysts (lateral type) occur along the alveolar margin or between teeth Clinical symptoms are those of displacements of the teeth and when associated with the inferior third molar develop posteriorly and up into the ramus giving expansion as do other follicular

cysts. Pathological findings and roentgen examinations are comparable to those in radicular and follicular cysts The treatment is removal of the cyst wall and adjacent teeth

Dentigerous cysts. Dentigerous cysts always contain the crown of the tooth although the tooth may be widely displaced from its point of origin (Fig 267 A and B) This is the most common cyst of the jaw, and occurs in order of frequency as follows in the region of the inferior third molar superior cuspids, superior third molars, and remaining permanent and deciduous teeth (Thoma) In the early stages, there is no suggestive symptom other than the non-eruption of the tooth Later as the cyst grows there may be expansion of the jaw so that the cortex of the bone becomes thinned sufficiently to produce a crackling sound when compressed because of the thin parchment like consistency of the cortical bone Evidently the enamel function of the tooth germ has ceased as the crown of the tooth is usually fully developed As the cyst expands the pressure within it prevents the tooth from erupting, the tooth being pushed apically away from the occlusal surface of the jaw (Fig 268 B and C) To give a clearer idea of the relationship of a dentigerous cyst to the enamel organ, attention is called to the dark line (potential cyst) around all unerupted teeth It is the widening of this line that is indicative of cyst formation In the roentgenogram there is a large radiolucent area with regular edge surrounded by a white line of condensed cortical bone. The crown of the tooth is seen within the cyst. Should the edges of the cyst show small rounded irregularities (soap bubble or honeycomb appearance) adamantinoma must be considered

Cystic odontomas differ from dentigerous cysts to the extent that the root and the crown of the teeth are both present Instead of one normal tooth being formed and present in the cyst (dentigerous) there are a number of teeth

Fig 266. Radicular cyst associated with a diseased tooth. There are no trabeculations or evidence of calcification within the cyst The wall is of dense bone and clearly defined Interruption of the lamina dura can be noted. Arrow indicates the associated tooth

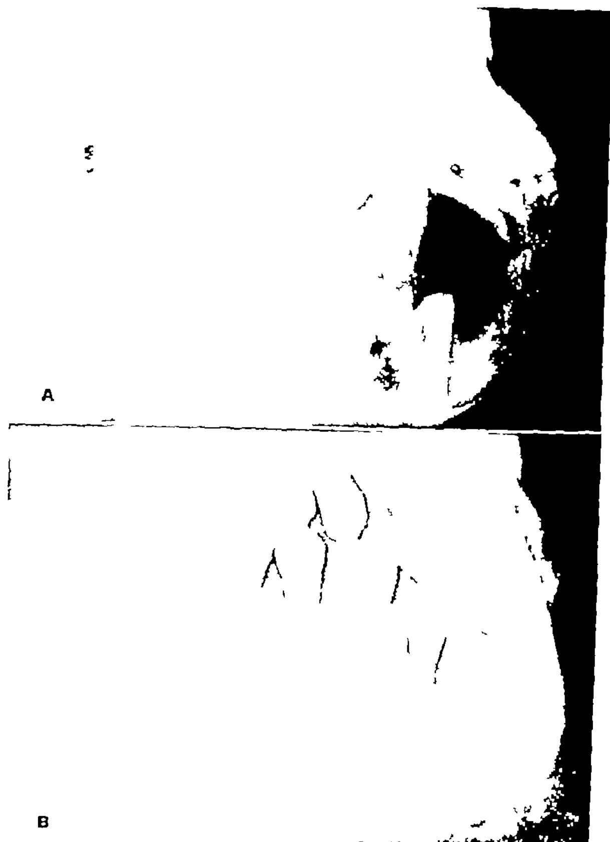


Fig 26[illegible] (A-B)

A Large dentigerous cyst forming around the crown of the lower canine tooth Note that pressure of the cyst has *pushed the root of the tooth down to the base of the jaw*

B Taken a year later after drainage of the cyst shows the canine tooth gradually moving up towards normal position Also, note that the third molar which was barely visible in Fig A, is now well formed The enamel organ around the crown of this tooth is shown as a little dark line

irregular in shape and size, or a conglomeration of tooth tissue fused into a mass by fibrous tissues, cementum or bone (see Fig 286 B) Since the enamel organ is very dense, and since the roots of the teeth are formed from mesoderm and therefore bone like, a mottled appearence occurs in the roentgenogram, indicative of this mixture of mesodermal and ectodermal elements The odontoma may be in the cyst lumen or it may be alongside the cyst.



Fig 267 (C)

C Roentgenograph of small dentigerous cyst in the mandible Future crown of tooth is within cyst.

Multiple follicular cysts occur through malformation of two or more adjoining tooth germs

Treatment of all odontogenic cysts is surgical the cyst is opened contents evacuated and the cyst wall curretted out If a tooth is present it must be removed in order to cure the condition Likewise, if odontoma is present the tumor must be removed Some authorities have obtained good results by prolonged drainage of the cyst a rather tedious procedure and not generally accepted The cavity is packed with gauze containing a granulation stimulant such as iodoform and the packing changed frequently until the bone cavity has filled in.

Pathological examination of the specimen shows a connective tissue wall with or without lining epithelium Contents may vary from thin clear amber-colored fluid to thick mucoid material There may be cholestern crystals, giving a metallic luster

ODONTOGENIC TUMORS

Odontogenic tumors comprise those neoplasms arising from any portion of the tooth germ and which histologically resemble either the mesodermal elements of the tooth root or the ectodermal elements of the enamel organ, or both.

The reader is referred to Chapter II on embryology for information regarding the development of the enamel organ which crowns the root of the tooth For clarity a brief resume follows

The enamel organs are epithelial appendages from the oral epithelium Figure 269 shows the tooth bud spreading out over the developing tooth root from mesoderm This process of development is comparable to that of the tunica vaginalis which invests the testicle As the testicle descends into the scrotum it carries along with it an attached bit of peritoneum for a covering over of the testicle The infundibulum connecting the peritoneal cavity the tunica vaginalis degenerates and disappears Should, however any portion remain, various types of hydroceles and hernias may form later in life. In a similar manner, the epithelium that is destined in the jaw to form the enamel organ, has an infundibulum connecting the enamel organ with the surface, which usually disappears. However small portions may remain as epithelial rests which may give rise to cysts or tumors later in life Also there are tiny off-shoots or buds from the side of the original tooth germ which may be broken off and remain dormant to grow under some subsequent stimulus in later life

AMELOBLASTOMA (ADAMANTINOMA)

The adamantinoma was first described by Malassez in 1885 The word *adamantinoma* is a bit misleading, as there is no enamel formed in the tumor More recently the terms *adamantine epithelioma* and *ameloblastoma* which signify that the tumor arises from enamel organ epithelium or the ameloblast, have come into common usage

The oral epithelium normally has the potentialities of developing several different types

of adult structure namely squamous cells, mucous glands, salivary tissue, tooth buds (enamel organs) thyroid tissue, and Rathke's pouch of the hypophysis Since the epithelium overlying the jaw and its several derivations all come from the same primitive epithelium it is not uncommon to find all gradations of epithelial tumors from ameloblastoma or adenocystic basal cell epithelioma or salivary tissue tumor over to squamous cell carcinomas and other malignant growths The clinical picture of many ameloblastomas adenocystic



Fig 268

A. Large dentigerous cyst of the upper jaw presenting through the hard palate Right third upper molar unerupted

B A P view showing unerupted third molar pushed laterally and upward

C Lateral x ray showing unerupted third molar tooth pushed high up behind the right orbit

D Photomicrograph showing strands of basal dental epithelium in the cyst wall a potential source of future adamantinoma. Treatment removal of cyst wall and extraction of unerupted third molar through the mouth. Caldwell Luc procedure (Patient of Edward A Looper)

basal cell epitheliomas and salivary tissue tumors in the jaw itself are often similar All of these tumors expand the jaw without ulceration, except following trauma or associated with infection The main clinical difference between adenocystic basal cell epitheliomas on the one hand and ameloblastomas and salivary tissue tumors in the lower jaw on the other, is that the former (adenocystic basal cell) often begin with pain. We have had two such cases in the lower jaw There was expansion of the bone with pain and irregular bone destruction visible in the roentgenogram In both of these cases the mucosa healed after biopsy a reaction not seen in the presence of squamous cell carcinoma We have had several cases of adenocystic basal cell epithelioma of the upper jaw in whom pain was not a common symptom

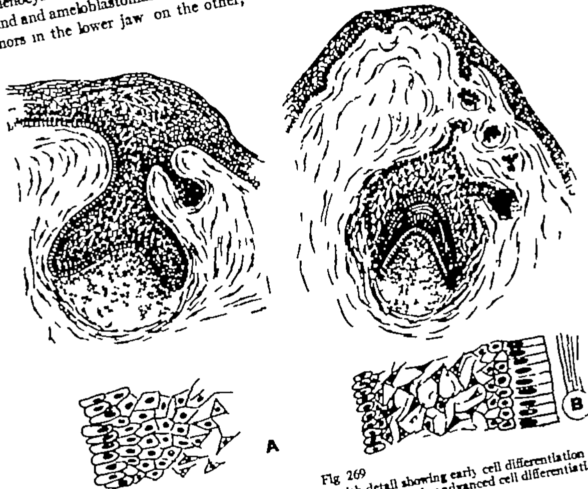


Fig 269

A. Tooth development early stage of enamel organ with detail showing early cell differentiation
B Tooth development fully formed enamel organ with detail showing advanced cell differentiation. (Courtesy Kurt Thoma and Charles C. Thomas.)

The late Joseph C Bloodgood taught that ameloblastoma was the one tumor that caused expansion of the jaw without ulceration and that the mucosa healed over the ameloblastoma after biopsy unless the biopsy is from a large cystic area We have discovered that these characteristics are possessed by other tumors namely adenocystic basal cell epitheliomas of the jaws and salivary gland tissue tumors in the jaws. Because of the similarity in clinical pictures and because of the embryological origin of these tumors they must be thought of in the same connection both diagnostically and therapeutically Further detailed discussion of these tumors will be given in their corresponding places in the text

As the enamel organ differentiates, three types of epithelial tissue develop The secreting cells next to the tooth become columnar the outer layer of the enamel organ develops a rounded or oval epithelium the intervening

cells become large irregular and stellate Histologically an ameloblastoma always has two or three of these types of epithelial structures

There are five sources of origin commonly ascribed

1 Malformed and supernumerary tooth germs.
2 Cell rests of the epithelial sheath of Hertwig
3 Odontogenic cysts.
4 Surface epithelium.
5 Displaced oral epithelium in other parts of the body

Ameloblastomas are not uncommon occurrences in the hypophysis. It is assumed that the bit of primitive oral epithelium which migrated from the vault of the pharynx to form Rathke s pouch undergoes metaplasia into ameloblastoma. Rare cases of ameloblastoma of the tibia have been reported but there is no satisfactory explanation of how such tumors occur in this location.

Clinical Behavior Ameloblastomas formerly were considered to be rare tumors They still are rarely seen by the average general surgeon but in medical centers they are not uncommon In 1935, Geschickter reported forty five cases from the surgical pathological laboratory of the Johns Hopkins Hospital. Since that time, we have collected sixty four cases from the Johns Hopkins Hospital the University of Maryland Hospital and our private practice. This number includes six cases of ameloblastomic carcinoma Two of the malignant ones were in children.

The symptoms of ameloblastoma are usually insidious. There may or may not be a history of injury The most common symptom is a slow painless expansion of the jaw without ulceration, at times continuing as long as fifteen or twenty years. In the earlier reported cases photos were shown depicting large massive growths with marked distortion of the face on one or both sides (Fig 2,8) (Case of William Longmire, J H H.) or marked protrusion of the mandible So often were huge ameloblastomas pictured in medical literature that the readers were inclined to look upon all such tumors as being large. Tumors attained great size because of slow insidious development without pain and often without serious interference with eating Apparently the patient became accustomed to the slow changes in the mouth and about the head Nowadays however more ameloblastomas are recognized in their early stages and properly treated by surgical excision

Ameloblastomas are much more common in the mandible than in the maxilla. Expansion is usually lateral, the lingual side of the jaw remaining almost normal until the tumor becomes large Now that the tumor is more readily recognized in the roentgenograph and many more cases come early the differential diagnosis is more difficult.

The tumor is usually irregular in shape and large, frequently cystic areas develop the walls of which often crepitate on palpation because of the thinned out bone giving a "derby hat crackle. The patients are usually in good health although with excessively large tumors there may be interference with eating and swallowing One of our cases beginning in the maxilla in a girl aged 10 (Fig 268), came to the University Hospital because of a painless swelling of the right cheek and bulging in the right hard palate Roentgenograph showed that the right upper third molar had not erupted but was pushed high up under the apex of the orbit There was a large radiolucent cyst like area, replacing the antrum, the walls of which were regular On removal of the cyst strands of basal cells were found to be growing in the wall, indicating the relationship between dentigerous cysts and ameloblastoma Futile attempts were made to follow this child in order to ascertain whether ameloblastoma developed later

The eruption or non-eruption of teeth is not constant enough to be a diagnostic sign If the ameloblastoma began in a dentigerous cyst then the crown of the unerupted tooth will be found in one of the cysts Many of the patients have had teeth removed for various reasons prior to coming to one of the clinics Insufficient local therapeutic efforts made

earlier in the course of the disease often confuse the clinical picture at the time of admission

Recurrences are common when incompletely removed There has been a general feeling among the dental and surgical professions that the treatment of choice is repeated curettage. This policy has been based on the fact that the majority of these tumors are slowly-growing and benign, and can be carried on for ten or fifteen years by repeated curettage every few years and maintenance of somewhat normal contour of the jaw We deplore such an inadequate form of treatment. Modern prostheses and transplantation of bones give such good cosmetic and functional results that radical resection of the mandible should be carried out in every case of ameloblastoma where the growth is sufficiently large to encroach upon the lower border of the jaw In the occasional case local resection may be carried out and enough of the mandible saved to prevent fracture and still maintain normal bony contour (Fig 277) Further discussion of treatment will be given under that heading

Pathological findings. Grossly these tumors vary markedly in appearance. The monocystic type apparently begins in a dentigerous or odontogenic cyst. The affected jaw is expanded to varying degrees, depending on the size of the tumor The cortex may be compressed to paper thinness and crackle under pressure. The bone may be completely destroyed but the periosteum usually remains The solid tissue has a whitish granular appearance, smooth and shiny Cysts of varying size and shape usually are scattered through the specimen (Fig. 278 C) The cysts contain a clear yellowish fibrinous or mucoid, and sometimes colloid, material so that the ameloblastoma tissue may not be found until careful microscopic examination of the wall of the cyst The roentgenographic appearance of an apparently benign cyst with irregularities along the edge particularly resembling honeycomb or soap bubbles, suggest ameloblastoma requiring careful histological examination of this region Sometimes such a monocystic adamantinoma is mistaken for a simple odontogenic cyst and treated conservatively Recurrence then proves the presence of an ameloblastoma at the site of the irregularity in the wall of the cyst demonstrable in the roentgenogram (Fig 277) It is obvious then that every cyst wall should be examined microscopically

In multicystic types the cysts may be small or large communicating with one another or separated by bony trabeculae (Fig 270) Radiolucent areas appearing as cysts often contain solid masses of ameloblastic tissue (Fig 271 A and B) Other solid types appear in the roentgenograph as a multicystic tumor made up of many tiny cysts giving the whole involved area of the jaw the appearance of honeycomb or soap bubble formation. These apparent tiny cysts are full of solid masses of adamantinoma tissue (Fig 272 A–F)



Fig 270. Large cystic type of adamantinoma. Note the complete septation between cysts.

Histology The microscopic appearance of ameloblastoma is variable Since the tumors arise from tooth germ epithelium, the histology may resemble any one of many stages in the development of the ameloblast Most ameloblastomas arise after cell differentiation into the two or three types of epithelium tumors then resemble the several stages of development Various combinations occur i.e , cuboidal epithelium and stellate cells or tall columnar epithelium and stellate cells or perhaps in some areas, all three types may be represented.

Strands of epithelium are seen with columnar epithelium on one side and cuboidal epithelium on the other with the central portion made up of stellate cells more frequent in the cystic variety The solid types are composed of strands of epithelium retaining the basal cell appearance In one of our cases (Fig 271 A and B) the cells were arranged in large columns



Fig 271

A Large multilocular cystic areas in the jaw The small daughter cyst anteriorly suggests adamantinoma.
B Photomicrograph showing adamantinoma of the epithelioma type

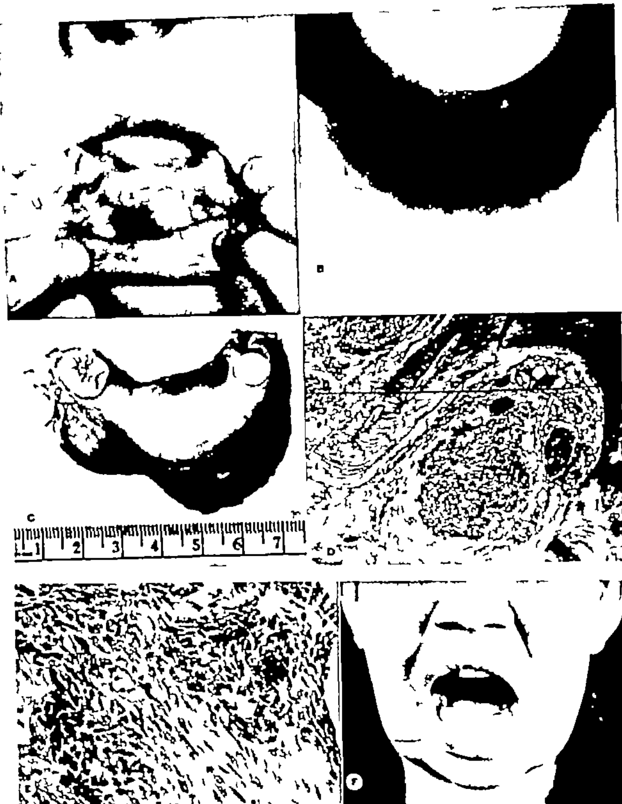


Fig. 272

A Large adamantinoma of the symphyseal region Patient had had her teeth removed and jaw curetted prior to admission.

B Roentgenogram showing honeycombed appearance so typical in some types of adamantinoma

C. Gross specimen. Surgical resection was carried out through the mouth. An incision was made in the gingivolabial sulcus and the soft tissues of the chin stripped back. The bone was severed on each side with a gigli saw This patient had sufficient mucous membrane that the wound could be closed in the mouth with primary healing

D Low power photomicrograph showing stellate type of adamantinoma invading bone.

E. Photomicrograph of stellate type of adamantinoma masses of stellate cells are surrounded on both sides by low cuboidal cells, representing the differentiation seen in the second stage of tooth development.

F Postoperative picture Patient wears a well-fitting prosthesis which fastens onto the remaining molar teeth by clasps giving good functional results. She has refused plastic repair

simulating a cylindroma Thoma (1944) gives an excellent histopathological classification of ameloblastomas which we follow

1 Epithelioma type The epithelial cells show very little tendency to differentiate and remain more or less basal in character Under the microscope they appear in cords or strands in a loose, fibrous stroma and generally form a *solid tumor* (Fig 271 B) In this tumor the stroma may take on the characteristics of a fibroma with small strands of epithelial cells scattered about Thoma speaks of it as a *fibro-adamantinoma*

2 Stellate type The epithelial cells are predominantly stellate-shaped, as seen in the enamel organs (Fig 272 A–F) The masses of stellate cells are surrounded by low cuboidal cells, representing the differentiation seen in the second stage of tooth development

3 Ameloblastic type Lobes and follicles are present which are made up of cells found in the third stage of development of the tooth germ (Fig 273 A) At the periphery the cells are cylindrical The cylindrical cells approach *the morphology of the ameloblasts* but do not *attain the normal ameloblastic function*

Thoma continues to say that "although n[o] enamel forms we see a homogeneous zon[e] between their basal membranes and th[e] *stroma* which must be considered an abo[r]tive enamel formation The stellate cells i[n] the central part of the follicle may underg[o] degeneration and cysts form

4 Acanthoma type This variety contain[s] squamous or prickle cells with a tendency t[o] form epithelial pearls (Fig 273 B) One readily recognizes that this may be a step toward the formation of carcinoma

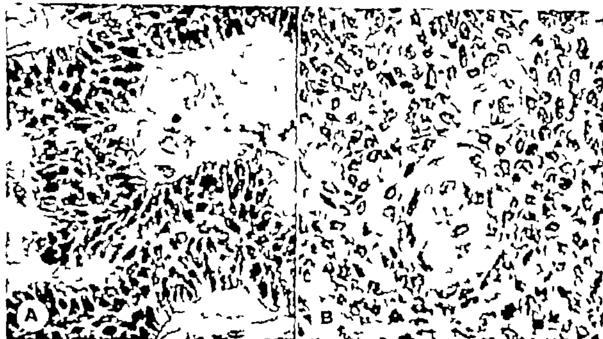


Fig 273

A. Photomicrograph of ameloblastic type of adamantinoma.
B Photomicrograph of acanthoma type of adamantinoma. Note epithelial pearls in center of illustration.

5 Ameloblastic carcinoma In one of our cases (Fig 274 A–D) recurrence developed after conservative and incomplete removal In the recurrence, there were sheets of squamous cells not unlike those seen in the squamous cell carcinoma This patient has remained well for many years after radical resection of the symphyseal portion of the mandible She has subsequently undergone plastic repair and bone transplantation Cases are reported in the literature that have metastasized (Thoma Byars and Sarnat) Figure 279 A F is of a child seven years of age having a central mandibular



Fig. 274

A Cystic adamantinoma in the symphyseal region Note multilocular character with partial septation.
B Low power photomicrograph showing sheets of squamous cell carcinoma.
C High power giving detail of carcinomatous invasion.
D Roentgenogram of another patient with extensive adamantinocarcinoma. Note extensive destruction of right mandible without sclerosis, indicating malignancy rather than osteomyelitis. The predominant picture is one of malignancy No characteristic of adamantinoma can be seen. Diagnosis proved by biopsy

tumor of epithelial origin and markedly undifferentiated He has been well six years following resection of the involved portion of the mandible.

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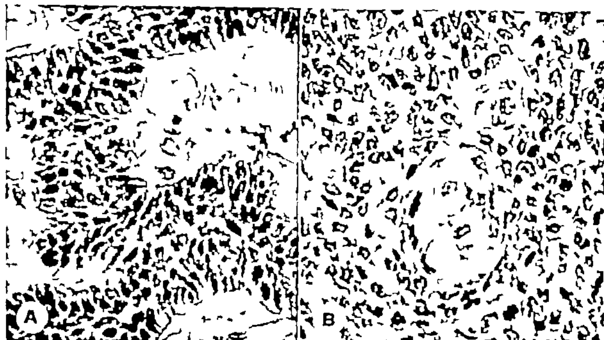


Fig 273

A. Photomicrograph of ameloblastic type of adamantinoma

B Photomicrograph of acanthoma type of adamantinoma Note epithelial pearls in center of illustration

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6 Melanotic ameloblastoma We have not had any of these in our series Thoma quotes Mummery and Pitts, who report an encapsulated tumor showing typical ameloblastoma cells also epithelial cells containing pigment

7 Hemangio-adamantinoma This type again is rare and shows a histological picture of ameloblastoma with large blood spaces filled with red cells, replacing the stroma and appearing to be lined by cylindrical tumor cells (Thoma quoting Kuhn and Oesternc)

8 Adeno-ameloblastoma Since oral epithelium has the potentiality to form glandular and dental structures it is not surprising that occasionally a tumor occurs in which the epithelium in its differentiation tends to grow towards glandular structure and arrangement, as well as resembling to some extent the adamantinoma Two of our cases (Fig 281 and 282) which are diagnosed as adenocystic basal cell epithelioma, gave clinical histories not unlike ameloblastoma, except that their illness began with pain There was expansion and destruction of the jaw and in both cases the mucosa healed over the biopsy wound Both died with clinical metastases. Unfortunately the lymph nodes were not biopsied. The ability of all epithelium to develop dental as well as glandular structures was emphasized by Thoma (1944)

Roentgen examination. Most authorities agree that roentgenographs of the jaw are not sufficiently accurate to allow an absolute diagnosis of ameloblastoma in every case also every well-circumscribed radiolucent area is not always a simple cyst However there are a few roentgenographic changes in the jaw suggestive of ameloblastoma. Inasmuch as ameloblastoma and cysts arise from dental epithelium having their origin in the same embryological anlage the presence of ameloblastoma in an otherwise regular walled dentigerous or follicular cyst should always be borne in mind Large multilocular cysts of long standing are more apt to have ameloblastoma cells in their walls than simple unilocular cysts Small accessory cysts adjoining any odontogenic cysts should be looked upon with suspicion as possibly containing ameloblastoma cells Small areas of soap bubble or honeycomb appearance or motheaten irregularity along the edge of a cyst extending into the bone are suggestive signs of ameloblastoma Some ameloblastomas (Fig 272 A) show no large cysts but the whole involved area is made up of tiny cysts having the appearance of a mass of soap bubbles or a cross section of honeycomb Teeth may be enclosed in one of the cysts or may be completely surrounded by tumor or teeth may be displaced at a distance from their normal site The roots of adjacent teeth may be denuded by pressure of the tumor and resorption of the surrounding alveolar bone (Thoma) Central giant cell tumor and central myxofibroma (Figs. 306, 307 311) are sometimes confused with ameloblastoma, as multilocular radiolucent areas are present with or without trabeculations, and because these two benign lesions may show irregularity of the cyst walls Expansion of the jaw is more marked in ameloblastomas than in myxofibroma or giant cell tumor Ameloblastomas of short standing may not expand the jaw Thoma emphasizes that myxofibromas have trabeculations that tend to form lines through the tumor instead of round compartments. After a very careful roentgenological study the final diagnosis of ameloblastoma is always made by microscopic examination

Prognosis. The outlook for most ameloblastomas is good provided adequate and thorough treatment is given when the patient is first seen Repeated curettage only serves to keep down the size of the growth and permits the patient to run the risk of malignant recurrences later Small tumors not involving the entire depth of the jaw are resected intraorally with a wide margin of normal bone yielding a good cosmetic and functional result and also a good prognosis Most of our cases have required radical surgery either because of the extent of the growth when first seen or because they have had repeated conservative surgery without permanent beneficial results Simmons thinks that cases in which the cuboidal cells predominate are probably the more malignant

forms of growth and that the cystic types with well-developed ameloblast like cells are more benign. This confirms our experience.

Treatment of ameloblastoma. Our experience with patients having ameloblastoma who have

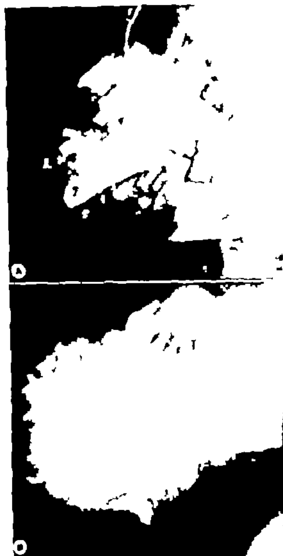


Fig. 275 Illustrates an ameloblastoma developing 8 years after trauma. Teeth removed four or five years ago.

A. Destruction of mandible. Patient refused surgery at this time (6/25/35)

B. Roentgenogram taken 10/13/39. Progression in size of ameloblastoma. The picture of each is suggestive of ameloblastoma

been treated conservatively over a period of years, plus those patients who have refused radical surgery has led us to believe that the best method of treatment is radical resection of the full thickness of the mandible with a margin of 1 cm on each side of the growth except in the small early cases where a substantial portion of the lower edge of the bone can be saved leaving a safe margin on all sides of the growth. This opinion is borne out by Simmons and Ivy and Curtis. Most of our cases have required an extraoral approach.

The main objection of many surgeons and dentists to radical resection for ameloblastoma is based on the assumption that deformity and disfigurement result. These objections are outweighed by two facts. First, curettage and incomplete resection serve only to permit re-



Fig. 276. Roentgenogram of ameloblastoma of one year's duration. Histological diagnosis ameloblastoma. The tumor involved the left mandible. The roentgenogram is more consistent with that of complex odontoma. No septation is seen

currences and run the risk, small as it may be, of malignant change in the recurrences. Second, modern surgery including bone grafting and the use of prosthetic appliances reduces deformity and dysfunction to a minimum (Figs. 278 and 306, Chapt. XXI)

Quick (1938) advocated external radiation followed by conservative surgery and local application of radium. A few of our patients who refused radical surgery were radiated against our better judgment both by x ray externally and radium directly applied to the bone. Such palliative measures have brought grief. In one of our cases radio-osteonecrosis occurred with secondary infection resulting in eventual loss of the mandible and more

marked disfigurement than if the mandible had been resected primarily These patients then had to go through long series of plastic opera tions.

Preoperative preparation Elimination of all oral sepsis is a prerequisite of operations in and about the mouth Teeth within the field of the proposed resection are extracted several weeks prior to the major operation allowing healing of the mucosa and permitting the ex traoral resection without opening into the mouth At the same time a biopsy is taken to assure the accuracy of the clinical and roent genological diagnosis

Anesthesia Jaw resections are done under general anesthesia The induction is begun with intravenous pentothal sodium An intratra cheal tube is then inserted preferably through the nose unless there is nasal obstruction when the tube is passed through the mouth Anes thesia is continued with inhalation of oxygen and nitrous-oxide. Ether vapor is dangerous while electrosurgery is employed about the mouth and face. The pentothal sodium is con tinued during the operation up to a usual maximum of two grams

Operation for small tumors Conservative in traoral operation for small ameloblastomas as shown in Figure 277 A B and C has a definite place The patient is anesthetized with pento thal sodium as a basal anesthesia followed by intratracheal oxygen and nitrous-oxide The pharynx is packed off The mucous membrane overlying the tumor is dissected back and if not too thin, is saved to cover over the defect The involved bone with a margin of 1 cm of normal bone is resected bleeding is controlled by bone wax or jell foam and the mucous membrane flaps re sutured Great care is exer cised to leave sufficient cortical bone at the lower border of the mandible to prevent subse quent fracture

Radical extraoral resection of the mandible for ameloblastoma The operation is carefully planned ahead of time The reader is referred to the section on bone grafts by Kitlowski and prosthetic appliances used in replacement of the jaws by Pyott for more complete details (Chapt XXI)

Fortunately most patients with adamanti noma have enough good teeth that some form of intraoral appliance can be made preopera tively by the dental consultant to hold the normal mandible in proper occlusion while postoperative healing proceeds Such appli ances usually have an inclined plane riding against the upper teeth allowing ample motion of the jaw in the normal plane This appliance may be inserted before the operation or imme diately after before the patient leaves the operating room Such appliances are of value particularly when the mucous membrane over lying the tumor is so thin that the mouth may be opened during the operation risking infec tion of the wound Immediate bone grafts, as a rule, are contraindicated in such circumstances. With modern antibiotic therapy however Longmire operated on one of the reported cases (Fig 278 A, B and C) in whom the mouth was entered during the resection be cause of the thin mucous membrane stretched over a massive tumor and without infection of the immediate bone graft This is a risk that must be taken only rarely and under the best controlled conditions. Byars and Sarnat (1945) report the use of steel bars interposed between the fragments at operation after removal of the jaw Such bars hold the fragments in place until adequate healing These bars can be re moved at a later date and replaced by bone grafts (See Chapt XXI)

When resecting the body of the mandible only the incision is made below the mandible through the skin subcutaneous fat and pla tysma muscle The mandible is carefully out lined and the mucous membrane of the jaw dissected away The jaw is severed with a Gigli or a rotary motor saw at a centimeter's dis tance on each side of the growth The wound is closed in layers After six months to a year bone grafts are transplanted giving normal function

Resection of the body and ramus of the jaw with or without disarticulation at the temporo mandibular joint An incision is made in the

skin of the neck about 2 cm. below the edge of the mandible and preferably in one of the natural folds of the skin, extending from back of the angle of the jaw or just beneath the lobe of the ear forward as far as is necessary to give adequate exposure in front of the anterior limits of the tumor. The incision is carried down through subcutaneous fat and platysma muscle. The skin of the cheek is reflected upward with the lower pole of the parotid, the latter to prevent injury to the inframandibular branch of the facial nerve as it emerges from the lower margin of the parotid gland to supply the lower lip. The mandible is then outlined by dissecting away soft tissue on all sides. If the teeth have been removed preoperatively it is possible to resect the jaw without opening the mouth; when teeth are present the mouth must be opened, running the risk of contamination. Fortunately present-day antibiotics



Fig. 277

A. Multilocular cystic area of right mandible involving roots of teeth. Note small daughter cysts extending posteriorly.
B. Bite-film showing honeycomb appearance suggestive of adamantinoma.
C. Roentgenogram 6 years after local resection. No clinical recurrence to date. The irregularities in the jaw back of the cysts have not changed in several years.

limit this otherwise troublesome complication Byars and Sarnat advise the saving of as much periosteum as possible In most of our cases we have resected the periosteum along with the bone in order to give a sufficiently wide margin of safety The mandible is cut through in normal bone a centimeter anterior to the tumor using an Albee or Gigli saw permitting manipulation of the posterior fragment an important maneuver particularly if the jaw is to be disarticulated at the temporomandibular joint The soft parts are then dissected backward and upward A periosteal elevator or sharp dissection separates the masseter muscle from the lateral aspect of the ramus and the pterygoid muscles from the medial aspect When the ameloblastoma does not extend far into the ramus the bone may be cut across at a centimeter margin from the posterior and upper limits of the growth In more extensive cases disarticulation is necessary

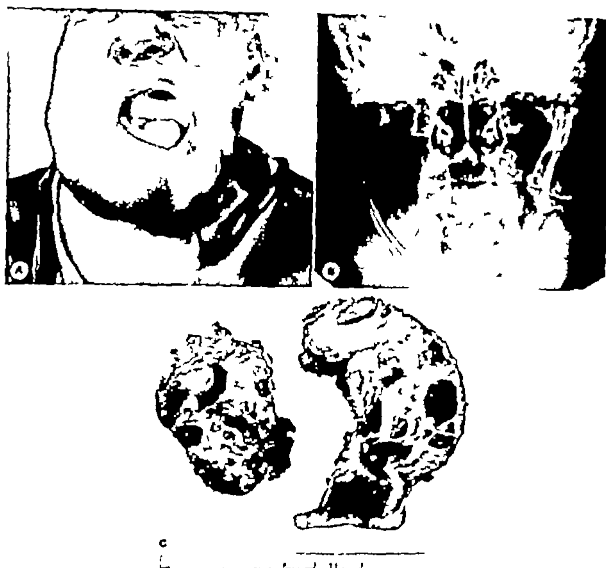


Fig 278

A Photograph of patient with huge adamantinoma involving the entire right mandible and a greater portion of the left

B Following complete resection of the right mandible and a portion of the left mandible to above the angle, rib grafts were put in immediately These have taken well and when last seen more than 1 yr after operation, good *firm alveoli were developing over the transplanted rib.* Patient had good function.

C Gross specimen showing large cystic areas throughout the tumor The large specimen was from the right side the small one from the left side (Case of William Longmire)

Maintenance of bone fragments More elab-

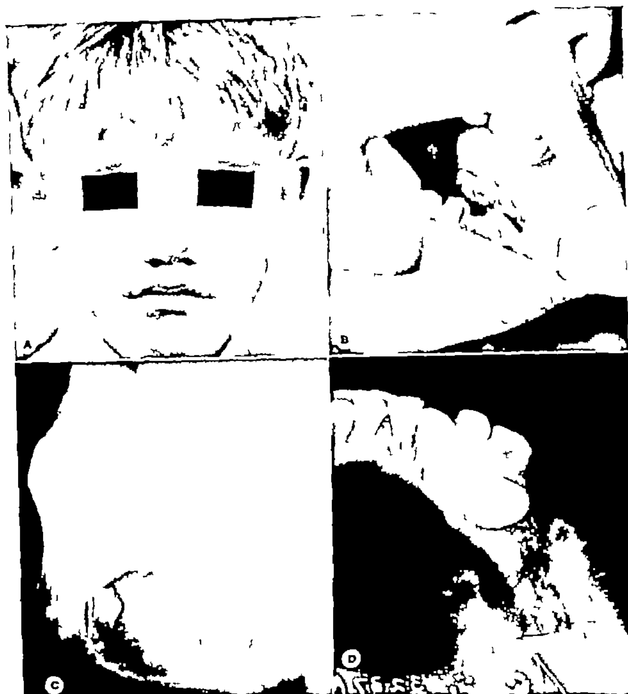


Fig 279 A white boy aged 7 came to the clinic with pain in the left mandible with expansion of the bone and a soft tumor growing up through the mucous membrane He had had his lower teeth removed elsewhere because of the pain and swelling.

A. Clinical photograph of patient on admission.

B Photograph showing tumor growing from the left mandible

C Lateral roentgenogram of left mandible showing finely mottled destruction of bone No new bone is seen Edges of defect are irregular suggesting malignant invasion

D Bite film roentgenogram showing radiating spicules of bone extending out from the jaw suggesting osteogenic sarcoma.

orate details of technics for maintenance of bone fragments is given in a special section (Chapt XXI) When the mouth has not been opened an immediate bone graft of rib or piece of ilium is done preventing displacement of remaining stumps of jaw an ideal procedure which should be utilized whenever at all feasible

It is important to maintain the normal occlusal position of the bone fragments during healing as scar tissue and muscle pull often dislodge both anterior and posterior fragments

when not stabilized the anterior fragment is pulled to the operated side and rotated backward. The posterior fragment is pulled forward and inward, at times causing pain by impinging on the posterior alveolar tuberosity of the upper jaw

If the ramus has been disarticulated then it is necessary only to hold the anterior fragment in occlusal position When patients have good teeth on the normal jaws this can be done best either by wiring the teeth or by the preoperative preparation of an appliance which will allow free motion of the normal jaw in its occlusal line (inclined plane) (See Section on Prostheses) We prefer the inclined plane The edentulous mandible is held in normal position by Haines splint (see Fig 242 B)

When the ramus of the mandible has not been disarticulated and an immediate bone graft is not advisable a steel bar as recommended by Byars and Sarnat may be inserted between the stumps of the bone Milton Edgerton has developed an excellent bar for this purpose. (See Chapt XXI and Color Plate VIII)

The wound is closed in layers If the mucous membrane has been opened its edges are approximated with interrupted or continuous zero chromic catgut submucous sutures Great care must be taken to cover the stumps of the bone to prevent infection and osteomyelitis These complications have not been troublesome to our patients Care is exercised to approximate the soft tissues for the best cosmetic result and to leave a good bed for subsequent bone graft if indicated When the mouth is opened a small drain is left in the wound for a few days All of our cases now receive antibiotic therapy postoperatively

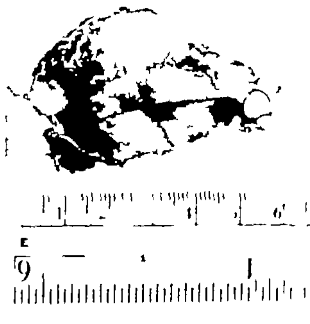


Fig 279 (E–F)

E. Cross specimen

F Photomicrograph shows a very anaplastic epithelial tumor invading bone Notice thick bone spicules. Pathological diagnosis anaplastic type of adamantinoma Follow-up Patient has been followed six years (last seen one year ago when he was free of disease) Wears a prosthesis. (Reported by Myron S Aisenberg Amer Jour of Orthodontia and Oral Surg., 28 36, 1942.)

Resection of Ameloblastoma of the Symphysis Mentis Resection of the anterior portion of both mandibles may be carried out intraorally satisfactorily It is inadvisable of course to put in a bone graft immediately after such an intraoral operation because of the possibility of infection If an immediate bone graft is

contemplated then the extraoral approach is preferred.

a safe distance behind the tumor The lip and chin soft parts are then stripped back beneath

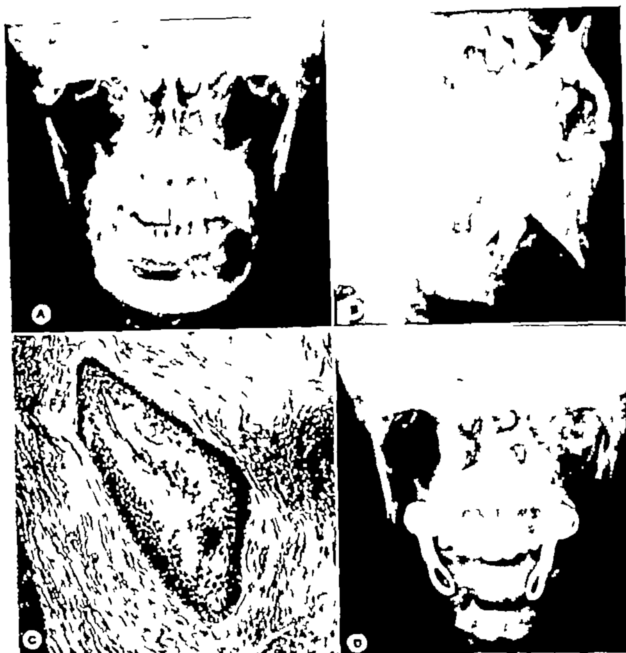


Fig. 280 (A–D)

A. Roentgenogram showing extensive multilocular radiolucent shadows suggestive of cystic adamantinoma.
B Lateral views.
C. Photomicrograph of ameloblastic type of adamantinoma. Note that the stellate cells in the center are beginning to degenerate to form a cyst
D Roentgenogram after intraoral resection of the jaw A prosthesis was placed in the unclosed mucous membrane wound immediately at operation. So much mucous membrane was lost that the defect could not be closed. Metal attachments of the prosthesis are well seen. (See text for technic.)

The incision is made in the mucous membrane of the buccogingival sulcus extending from well back of the site of growth on one side around the jaw anteriorly in the gingivo-labial sulcus, to the opposite side of the mandible at the mandible allowing it to project out of the mouth (Fig. 284) The mouth-floor muscles are then dissected away from the lingual side of the mandible. The jaw is cut through on each side at least a centimeter posterior to the most dis-

tal borders of the growth. *The problem of maintaining* bone fragments after such an extensive resection is a difficult one To complicate the picture the mucous membrane over these ameloblastoma of the symphysis is sometimes so thin that it cannot be safely preserved for closure It would then be impossible to bury either bone or a steel bar to hold the fragments in normal apposition

In 1946 Ward and Robben were confronted with just such a problem The patient (Fig *280 A–F*) had a large symphyseal adamantinoma involving not only the chin region, but most of the mandible on each side *After careful* roentgen study it was found that only the *third molar tooth on each side could be saved.* The mandible was resected through the mouth *from* just anterior to the third molar on one side to just anterior to the third molar on the other A prosthesis previously prepared by Riley S Williamson of the Baltimore College of Dental Surgery Dental School, University of Maryland was inserted in the mouth in the raw bed 1 5 cm wide and 7 cm long caused by the excision of the huge mandible and loss of mucous membrane The prosthesis abutted against the stumps *of the rami* and *maintained* the soft parts of the chin and lower face in *normal position* The *prosthesis* was held by *clasps, gripping* each third molar which had been capped previously with a gold crown. The *convalescence was uneventful* the patient wore the appliance constantly and was ambulatory post anesthesia and *promptly took* liquid diet In six days she was on soft diet and in twelve days postoperative was discharged with a full lower denture in place that is, the prosthesis carried a set of artificial teeth As indicated in Figure 280 F one could not tell that her mandible had been resected by simply looking at her with her mouth opened or closed

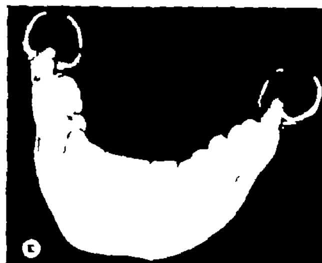




Fig. 280 (E–F)

E. Photograph of prosthesis which was placed in the mucous membrane defect Clasps held the prosthesis to the only remaining teeth—the third molar on each side

F Clinical photograph showing excellent functional and cosmetic results. Prosthesis in place (A, B D and F courtesy Plastic and Reconstructive Surgery)

The patient was allowed to wear the prosthesis *without removal for six months The mu*cous membrane of the floor of the mouth *grew under the prosthesis and* the soft tissues were in normal position also the mucous membrane grew over the stumps of the mandible between the bone and the acrylic prosthesis This growth of mucous membrane beneath the prosthesis is comparable to the growth of mucous membrane around a urethral catheter following prostatectomy Since this successful experiment we have had several other patients in whom prostheses were dropped into a raw surface left in the mouth by *resection of the mandible* with the same satisfactory regrowth of epithelium over the raw surface and beneath the prosthesis

At the time, we were not familiar with the reports of Kazanjian (1932 1934 and 1939) who had similar experiences He introduced a temporary dental compound mold shaped to approximate size of the removed tissue, which was left in place for ten days, removed and a temporary vulcanite restoration inserted. A permanent appliance was constructed and worn after the mouth wound healed (1932) His prosthesis incorporated a hinge at the junction of ascending ramus with the body of the mandible. In the 1934 report the permanent prosthesis was inserted at operation.

ENAMELOMA

These rare tumors are spoken of as enamel droplets or enamel pearls. They are found between the roots of two teeth or more frequently attached at the bifurcation of the roots of molars and premolars and at the cervical margin of single-rooted teeth (Thoma), and arise from remnants of the enamel organs. When they contain a pulp canal they are considered as supernumerary teeth.

Roentgen examination shows an extremely radio-opaque shadow without structure the density being due to the hard enamel itself

On microscopic examination epithelial cells are found surrounding the enamel which when decalcified appears as a clear space.

ODONTOMA

Odontoma is really a mixed tumor composed of ectodermal and mesodermal elements Because these tumors form an intermediary group composed of ectoderm and mesoderm they will be discussed after epithelial tumors

TUMORS ARISING FROM ORAL EPITHELIUM

As has been stated previously normally there are epithelial appendages (ameloblasts) in the jaw expressly for the purpose of forming *tooth buds*. Since these cells arise from oral epithelium which has several potentialities, tumors resembling epithelium that does not normally occur in the jaw are *occasionally* encountered such as adenocystic basal cell epithelioma, cylindroma like carcinoma, squamous cell carcinoma, and salivary mixed cell tumors the latter are discussed under mixed tumors

CENTRAL ADENOCYSTIC BASAL CELL EPITHELIOMA

These arise from the epithelial appendages that grow down into the jaw and resemble the adenocystic basal cell epitheliomas seen elsewhere in the mouth and on the skin We have not seen any benign ones. Thoma refers to a recurrent central adenoma reported by L. M S Miner and H A. Kent, of Boston. This benign tumor caused osteolysis and a cystic like lesion in the jaw A clear outline denoted benignancy A diffuse outline indicates local malignancy

In our 196 cases of jaw tumors reviewed, six showed adenocystic basal cell epitheliomas Ages varied from 51 to 60, there were five males and one female. Symptoms were pain, swelling, and disability in all six cases The duration of symptoms varied from one to four years. Previous treatment had consisted of extraction of teeth in four and conservative surgery in six Three were located on the upper and three on the lower jaw The differential diagnosis is sometimes difficult from a clinical and radiographic point of view The pain, rather rapid swelling and disability should make one suspicious of a malignant tumor Although these symptoms are present at times with ameloblastoma, the pain is not so common nor so severe, the disability late, and the swelling is much more slowly developing. Metastatic carcinoma can be fairly well ruled out by an adequate history general physical examination and x ray studies. Differentiation from osteomyelitis is sometimes difficult and only made by biopsy

Two cases which were treated by Ward prior to the present series are illustrative (Figs 281 A–D and 282 A–C) One has previously been reported by Geschickter This case was presented by the pathologist of the Church Home Hospital Vernon Norwood, before the American Association for the Study of Neoplastic Diseases in 1935

tal borders of the growth. The problem of maintaining bone fragments after such an extensive resection is a difficult one. To complicate the picture, the mucous membrane over these ameloblastoma of the symphysis is sometimes so thin that it cannot be safely preserved for closure. It would then be impossible to bury either bone or a steel bar to hold the fragments in normal apposition.

In 1946 Ward and Robben were confronted with just such a problem. The patient (Fig 280 A–F) had a large *symphyseal adamanti*noma involving not only the chin region but most of the mandible on each side. After careful roentgen study it was found that only the third molar tooth on each side could be saved. The mandible was resected through the mouth from just anterior to the third molar on one side to just anterior to the third molar on the other. A prosthesis previously prepared by Riley S Williamson of the Baltimore College of Dental Surgery, Dental School, University of Maryland, was inserted in the mouth in the raw bed, 1.5 cm wide and 7 cm long caused by *the excision of the huge mandible and loss* of mucous membrane. The prosthesis abutted against the stumps of the rami and maintained the soft parts of the chin and lower face in normal position. The prosthesis was held by clasps, gripping each third *molar which had* been capped previously with a gold crown. The convalescence was uneventful; the patient wore the appliance constantly and was ambulatory post anesthesia and promptly took liquid diet. In six days she was on soft diet, and in twelve days postoperative was discharged with a full lower denture in place, that is, the prosthesis carried a set of artificial teeth. As indicated in Figure 280 F one could not tell that her mandible had been resected by simply *looking at her with her mouth opened or closed.*

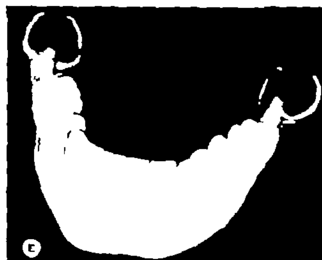




Fig 280 (E–F)

E. Photograph of prosthesis which was placed in the mucous membrane defect. Clasps held the prosthesis to the only *remaining teeth—the third molar on each side.*

F. Clinical photograph showing excellent functional and cosmetic results. Prosthesis in place. (A, B, D and F courtesy Plastic and Reconstructive Surgery.)

The patient was allowed to wear the prosthesis without removal for six months. The mucous membrane of the floor of the mouth grew under the prosthesis and the soft tissues were in normal position; also the mucous membrane grew over the stumps of the mandible between the bone and the acrylic prosthesis. This growth of mucous membrane beneath the prosthesis is comparable to the growth of mucous membrane around a urethral *catheter following prostatectomy*. Since this successful experiment, we have had several *other* patients in whom prostheses were dropped into a raw surface left in the mouth by resection of the mandible with the same satisfactory regrowth of epithelium over the raw surface and beneath the prosthesis.

At the time, we were not familiar with the reports of Kazanjian (1932 1934 and 1939), who had similar experiences. He introduced a temporary dental compound mold shaped to approximate size of the removed tissue which was left in place for ten days, removed, and a temporary vulcanite restoration inserted. A permanent appliance was constructed and worn after the mouth wound healed (1932) His prosthesis incorporated a hinge at the junction of ascending ramus with the body of the mandible. In the 1934 report the permanent prosthesis was inserted at operation.

ENAMELOMA

These rare tumors are spoken of as enamel droplets or enamel pearls. They are found between the roots of two teeth or more frequently attached at the bifurcation of the roots of molars and premolars, and at the cervical margin of single rooted teeth (Thoma) and arise from remnants of the enamel organs When they contain a pulp canal, they are considered as supernumerary teeth.

Roentgen examination shows an extremely radio-opaque shadow without structure, the density being due to the hard enamel itself

On microscopic examination epithelial cells are found surrounding the enamel which, when decalcified appears as a clear space

ODONTOMA

Odontoma is really a mixed tumor composed of ectodermal and mesodermal elements Because these tumors form an intermediary group composed of ectoderm and mesoderm they will be discussed after epithelial tumors.

TUMORS ARISING FROM ORAL EPITHELIUM

As has been stated previously normally there are epithelial appendages (ameloblasts) in the jaw expressly for the purpose of forming tooth buds. Since these cells arise from oral epithelium which has several potentialities, tumors resembling epithelium that does not normally occur in the jaw are occasionally encountered such as adenocystic basal cell epithelioma cylindroma like carcinoma, squamous cell carcinoma, and salivary mixed cell tumors the latter are discussed under mixed tumors

CENTRAL ADENOCYSTIC BASAL CELL EPITHELIOMA

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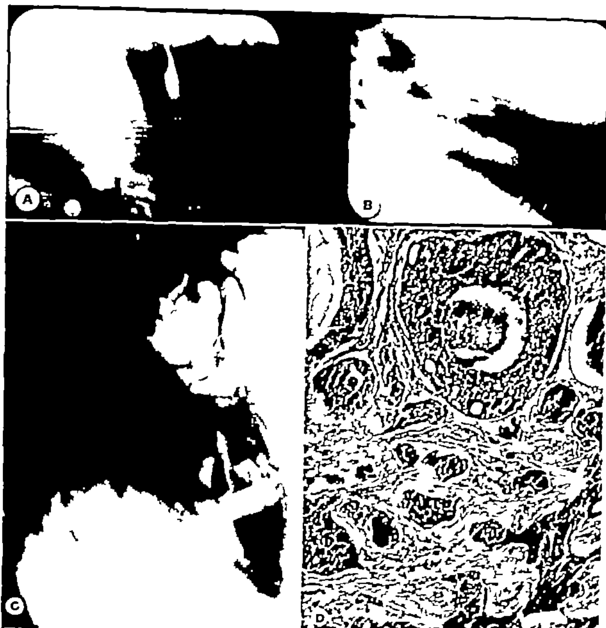


Fig 281 Adenocystic basal cell epithelioma of the left mandible

A. Roentgenogram taken ten months prior to admission. Note irregular radiolucent shadows which led to the diagnosis at that time of osteomyelitis.

B Roentgenogram of jaw taken a few months later The radiolucent shadows do suggest possible osteomyelitis with sequestrum formation Careful examination of histological slides made at that time which were submitted to us later showed basal epithelial cells filling the haversian canal system.

C. Roentgenogram at time of admission Jan 1935 Note irregular motheaten radiolucent areas indicating malignant invasion of the entire jaw It is interesting to note that a biopsy of this mandible was taken through the mucous membrane The mucous membrane healed over the biopsy wound a phenomenon which does not occur with ordinary squamous cell carcinoma It does occur with adamantinomas and other epithelial tumors that occur deep in the jaw and apparently arising from epithelial appendages.

D Photomicrograph showing typical adenocystic basal cell epithelioma (this case was reported by the pathologist of Church Home Hospital Vernon Norwood, before the American Assn for the Study of Neoplastic Diseases in 1935 and was recorded in the literature by Geschickter)

The patient aged 60 was a white man, referred to Richard Coblentz, neurosurgeon of Baltimore because of fifth nerve pain His present illness began ten months previously with pain in the left lower jaw running up the left face and into the ear The lower jaw was slightly swollen Two months later a dentist extracted the lower third molar root that had been left in for some years. The left face was then paralyzed There was temporary relief of the pain and swelling after the extraction of the tooth then it became worse. One month prior to admission a piece of bone was removed in another city and some pus obtained. Dental x-rays were taken on

several occasions (see Fig 281 A and B) also a biopsy was made and reported as confirmation of the x ray report osteomyelitis. Ward reviewed this slide in the light of adequate biopsy material when he saw the case. A few nests of basal epithelial cells could be seen in the volvement precluded any radical surgical operations. The patient received implantation of radon seeds as follows two 3 mc. seeds were implanted in the nodule in front of the left ear and two 3 mc. seeds into a nodule back of the angle of the jaw Eleven 3 mc. seeds were

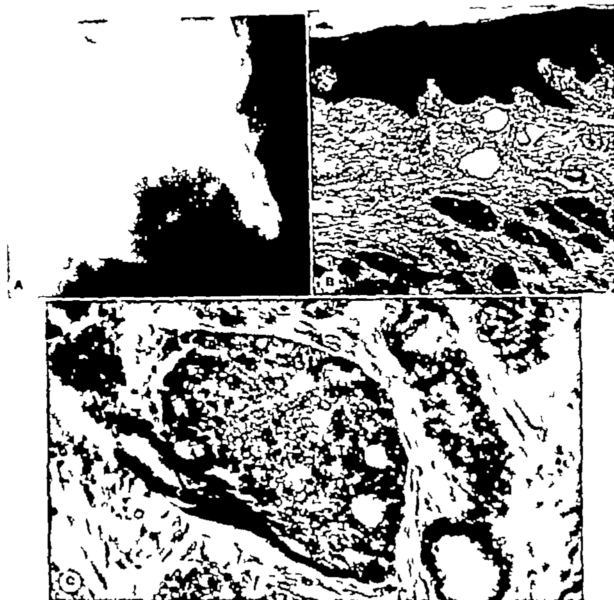


Fig. 282. Adenocystic basal cell epithelioma of the mandible left

A. Roentgenogram showing punched-out round, and irregular radiolucent shadows indicative of malignant invasion of the bone

B Photomicrograph showing basal cell type of tumor invading the deeper structures beneath the mucosa. This tumor did not ulcerate as indicated by the intact squamous epithelium above it.

C High power photomicrograph showing adenocystic basal cell epithelioma.

haversian canal system, which had apparently been overlooked by the previous pathologist. The roentgenographs shown in Figure 281 indicate marked irregular osteolytic areas in the jaw There were enlarged nodes in the preauricular and cervical regions, but unfortunately these were not biopsied. The jaw was biopsied and the diagnosis of adenocystic basal cell epithelioma made (see Fig 281 C) The extent of the disease in the mandible and the presence of clinical lymph node implanted into the left lower jaw distributed throughout the ascending and horizontal rami.

In this and a subsequent case which was biopsied through the oral mucous membrane, the biopsy wound healed (Fig 282 A–C) characteristic of adenocystic basal cell epithelioma and salivary tissue tumors in the jaw, and re-

sembles the reaction to biopsy of ameloblastoma, as pointed out by Bloodgood many years ago (personal communication) This suggests a close relationship between adenocystic basal cell epithelioma salivary tissue tumors, and ameloblastoma from an embryological stand point.

The second patient a white man, aged fifty-one, came in February 1937 complaining of pain in the left side of the chin since August 1935 Early in 1936 he noticed that his lower anterior teeth were loosening and that a lump appeared in the left side of the neck beneath the jaw His dentist extracted all but two teeth on the right and one on the left after palliative treatment failed to give relief The pain in the chin continued and "felt like a boil." Treatment for local infection was continued until he consulted another dentist who took an x-ray and diagnosed a "cyst" and scraped the bone. After the remaining tooth on the left was extracted numbness developed in the left side of the chin and gum indicative of inferior dental nerve involvement

Study of the dental roentgenographs made April 17 1936 revealed irregular diffuse bone destruction with the tooth socket still present, and many small cystic areas scattered throughout not unlike chronic osteitis fibrosa and suggesting solid ameloblastoma.

Later dental roentgenographs, taken February 2, 1937 showed the same cystic degeneration and more bone destruction. The tooth sockets were not so well defined and their edges motheaten and the thickness of the mandible definitely increased

Physical examination General appearance good, definite lag, with slight depression of the left side of the lower lip. There is slight puffiness over the left mandible extending down into the left side of the neck. In the left submaxillary triangle there is a definite almost stony hard mass, somewhat pyramidal in shape, with the base attached to the jaw and the apex near the greater cornu of the hyoid bone The tongue is protruded in the midline. The left lower jaw is expanded there are nodular swellings on the buccal and lingual sides from the angle around the front and across the midline to about the region of the first and second bicuspid teeth on the right. The mucous membrane over this area is red and infected. There is a sinus at the site of his former lateral incisor and canine teeth. No pus expressed. Palpation on the floor of the mouth is painful. This indurated mass is felt rather deep down in the neck. No nodes are made out other than the submaxillary mass Numbness begins at the level of the tragus of the ear and is complete just in front of the mouth practically in the midline The patient wears a complete upper denture

Discussion The clinical history and physical examination suggest chronic osteitis, adamantine (ameloblastic) epithelioma or adenocystic basal cell epithelioma. X ray reports (Feb. 25 1937 by John Evans)

Both mandibles (anteroposterior and lateral views) show small punctate areas of bone absorption throughout the greater part of the body This is especially marked on the left side, where there is also considerable absorption along the upper border of the alveolar process. Changes present a rather unusual appearance and suggest a low grade osteomyelitis more than any other condition Does not resemble Paget's disease Skull is also taken in the anteroposterior and lateral views and is essentially negative for bone change Sella turcica is normal Pineal gland is well calcified with a few minute calcified masses posterior to it."

Biopsy on February 27 1937 directly through the mucous membrane of the left lower jaw Diagnosis Ameloblastoma (adenocystic basal cell type) of jaw

It is interesting to note that the mucous membrane healed over the site of biopsy a clinical phenomenon in keeping with benign and malignant tumors of epithelial origin in the jaw The patient's pain disappeared and both the mass in the neck and the size of the jaw subsided markedly under x-ray therapy The improvement only lasted about four months and he later went downhill and died.

Treatment In the six cases in our series three were treated with radical surgery and three had radical surgery and x ray therapy Radical surgery included dissection of the entire involved area of the mandible, taking the periosteum Since this tumor is a malignant one, a wide margin must be given

Two of the six cases lived one year three lived three years, and the third could not be followed

CENTRAL SQUAMOUS CELL CARCINOMA

Since epithelial cells grow down into the jaw from the surface epithelium, it is not surprising that true squamous cell carcinoma is encountered rarely in the jaw possibly due to metaplasia In the section on ameloblastoma attention was called to the fact that in some malignant ameloblastoma there occurs a gradation of cell differentiation from the ameloblast over to the squamous cell carcinoma In our series of jaw tumors, two cases were found which, after careful study seemed to be true squamous cell carcinomas developing in the central portion of the lower jaw These were both males of forty four years of age The presenting symptom in one was pain and in the other pain and swelling Both had dis-

ability The durations of symptoms lasted one and two years, respectively On examination there was ulceration in one and infiltration of the surrounding tissue in both Both carcinomas occurred in the left mandible. Previous treatment consisted of tooth extraction and inadequate surgery One had x ray therapy

Roentgen examination of the jaw shows a radiolucent shadow with ragged edges and no new bone reaction



Fig 283 Dermoid cyst mandible. A unilateral area of destruction in the mandible without evidence of bone reaction or associated teeth. Radiographically this might represent a follicular cyst or a solid benign tumor However pathological diagnosis is *dermoid cyst* These are rare in the jaw

Treatment consisted of radical surgery with radical neck dissection in both cases The patients lived two and three years respectively after operation and both died of pneumonia.

DERMOID CYST

Dermoid cysts of the mandible are apparently a rare occurrence, as we know of none reported in the literature and have observed only one in our series (Fig 283)

The patient a forty-one year old white man, complained of a painless lump in the right mandible, just inside the mouth first noticed twenty-four years previously In the beginning the lump was the size of a pea and gradually increased. One year prior to admission it commenced to grow rapidly and five months prior to admission all the teeth in the right mandible were extracted because they were loose. Growth of the lump then increased markedly

On examination the right face was swollen. An ovoid mass the size of an English walnut apparently sprang from the alveolar ridge of the right mandible and projected within the mouth and below the jaw It seemed slightly fluctuant and tender The regional lymph nodes were not enlarged.

Roentgenographs showed a solitary radiolucent oval area with clear-cut regular edges and no bone reaction.

Treatment. Operative removal with uneventful recovery

Pathological Diagnosis Dermoid Cyst

TUMORS OF PERIPHERAL NERVE ORIGIN

Since the jaws are supplied with nerves, it is to be expected that occasionally tumors arising from the various nerve structures should appear in the jaws In our review of 196 jaw tumors we have not had any tumors which have been diagnosed as of neurogenic origin However in the literature, neurogenic fibroma and fibrosarcoma schwannoma (neurinoma), ganglioneuroma and amputation neuroma have been reported (Thoma Wilkens)

Since the completion of our study, a recent case has come under observation which was originally diagnosed as "Ewing's tumor" Other pathological diagnoses have been 'mesoblastic tumor of a reticulum forming type and "epitheloid tumor of peripheral nerve. This tumor was described by Lanford and I Cohn (1927) and I Cohn (1928) Similar tumors in bone containing epithelial elements have been reported by Bergstrand (1934) Stewart and Copeland (1931) make this suggestion 'There exists a group of tumors where the cell structure is epitheloid This tumor may bridge the gap between typical neurosarcoma and typical melanoma "

The following are the history and clinical and histological findings in our case (Fig 284 A-M)

The patient a white boy aged five years came for examination in October 1948, giving the following

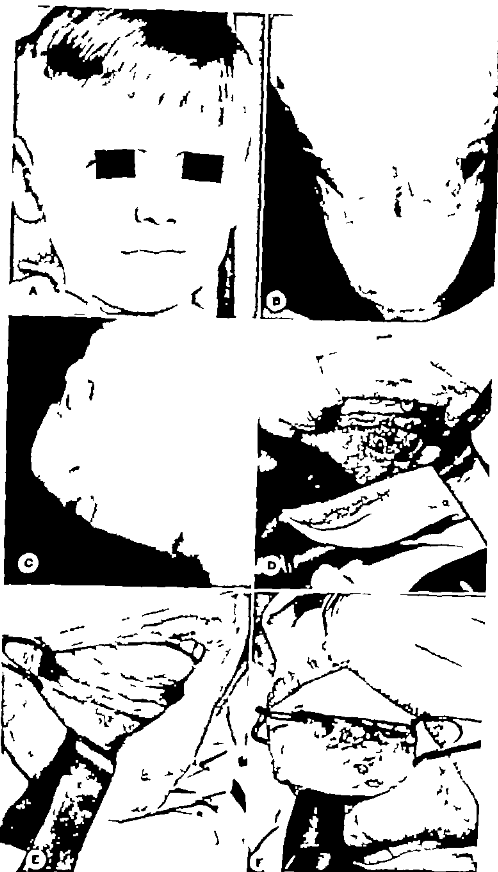


Fig. 284 Case of epithelial tumor of peripheral nerve (Cohn) of the mandible Patient a white boy aged 5 (See text for details.)

A. Full face view before operation slight prominence of the lower right mandible

B A P roentgenogram showing displacement of the permanent teeth in varying directions Some of the deciduous teeth were also displaced

C Lateral view of right mandible (Note one permanent tooth has been pushed down to the lower border of the bone) There is evidence of bone destruction with irregular bone trabeculation

D E and F Taken during the operation. Mucous membrane in the gingivolabial sulcus was incised and stripped back D View from left side E From right side F All soft tissues of the chin pushed back beneath the bone The mandible is ready to be resected with Gigli saw

history He had been well all his life until the present illness. The decidual teeth had erupted normally About two months prior to admission, the mother noticed a swelling in the right lower jaw without pain. One tooth

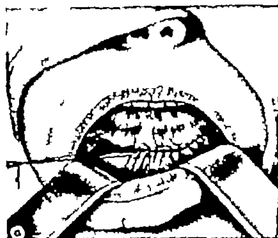


Fig 284 (G)
G Mucosa sutured over periosteum of mandible

left side as far as the premolar teeth. There was expansion of the mandible with extension of the irregularity into the middle of the floor of the mouth on the lingual side, as well as extension on the buccal side. Sockets where the teeth were recently removed have healed nicely General examination of other bones negative.

Roentgenograms of the skull, all the long bones, spines, ribs, and scapula were normal Roentgenogram of the chest No active lung infection although there was a slight amount of cloudy infiltration at the roots of the lungs.

On the basis of the pathological report the following roentgen therapy was given 12 treatments from October 7 to November 1 1948 1750 r was given to the right mandible and 1250 r was given to the left mandible. Treatment factors were 200 kv ½ mm. Cu, 1 mm. Al, hvl 95 mm. 15 Ma size of port 6 x 8 cm. T.S.D 50 cm.

Following this treatment there was no improvement in the clinical picture and no particular change in the roentgenograph. Since this tumor did not respond to x ray therapy like Ewing's tumor usually does and

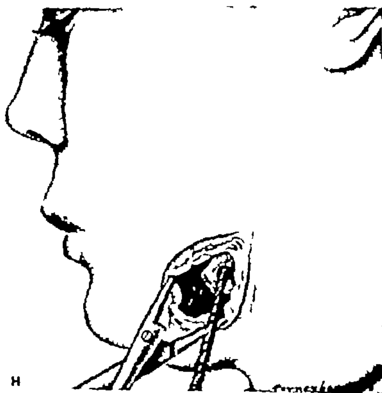






Fig 284 (H)
H. Extraoral incision over each angle of mandible. Bone bored for anchoring of stainless steel wire (inserts)

became loose. He was then referred to Howard Van Natta and Brice Dorsey exodontists. X ray films (Fig. 284) showed tumor in the lower jaw displacing the teeth in many directions. The loose teeth were extracted and a biopsy made. First pathological report Ewing's tumor

Examination on admission showed a hard, irregular swelling over the right mandible extending around to the

since other pathological diagnoses differed from the original, jaw resection was decided upon.

On April 12, 1949 under general anesthesia the jaw was resected subperiosteally through the intraoral approach, the mucous membrane over the jaw was incised from one side to the other the periosteum dissected back, and the jaw resected with a Gigli saw giving a margin to the tumor on the right side of about 1 cm.

On the left side the margin inadvertently was not quite so wide. The mucous membrane of the mouth was then closed with interrupted catgut sutures.

E. A. Kitlowski then fixed the posterior fragments back by wires attached through holes bored in the angles of the jaws, and attached to elastic bands running around back of the neck.

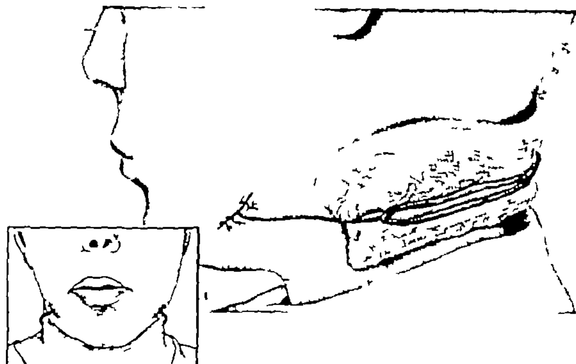


Fig 284 (I)

I Wires connected by rubber band back of neck maintaining constant traction on mandibular stumps. (This part of operation by E. A. Kitlowski.)



Fig 284 (J)

J Operative specimen. Tumor has bulged cortex of the bone at various places and along alveolar edge has actually broken through cortex

A few days postoperative a Gunning splint was inserted in the mouth to help maintain the soft parts in as normal a position as possible as a supplement to the posterior traction

In two months, roentgenograms showed new bone laid down by the periosteum sufficient to maintain the posterior fragments in normal position. Patient died of massive local recurrence without evidence of metastases.

CENTRAL MIXED TUMORS

Central Mixed Tumors of Salivary Tissue

The presence of these tumors in the jaw is theoretically due to either embryonic rests or metaplasia of the epithelial appendages. Most salivary tissue tumors in the mouth occur on the soft or hard palates or along the gingival borders in the mucous membrane itself. Formerly this type of tumor was regarded as a carcinoma of the adenoma type. The tumor develops in the bone without subjective symptoms; later there may be swelling of the cheek or face, depending upon the location of the tumor whether in the maxilla or mandible. Pain of neurologic burning or shooting character has been reported due to involvement of or pressure against the nerves.

Roentgenographs of central mixed tumors show a cystic lesion of varying outline. Coarse septa extend from the periphery into the tumor for a short distance and are likely to be irregular in shape, often expanding irregularly instead of running out into a point. Calcified trabeculae may be found in the center which

are partly calcified connective tissue structures formed in the tumor itself

Histology is that of a mixed cell tumor of salivary tissue, that is there are varying components of glandular epithelial structure and





Fig 284 (K–L)

K and L Photomicrographs showing epithelial-like glandular structures.

connective tissue The epithelial elements may resemble those in salivary glands and present small round spaces lined with low columnar or cuboidal cells. Squamous epithelium is quite common in the central mixed tumors forming sheaths and strands of cells arranged in parallel fashion In some tumors, epithelial pearls are found. Mesenchymal structures consist of fibrillar connective tissue, mucous tissue with a hyaline-like reticulum cartilage, fibrous or yellow, or elastic tissue and osteoid tissue.

Treatment is surgical Maitland (1947) reports an interesting patient with a salivary tissue like tumor in the right alveolus and antrum It was operated on several times and then treated with roentgen therapy The pa



Fig 284 (M)

M Roentgenogram 2 months postoperative. New bone formation proceeding in spite of preoperative roentgen therapy Massive recurrence one month after this roentgenogram.

tient remained free of disease for three years, up to the time of his report. The difficulty of making a positive diagnosis in some of the patients was illustrated by Maitland's case where the following conflicting pathological reports were given (1) Mixed cell tumor of salivary tissue (2) Hypertrophy and mild chronic inflammation (3) Chordoma (4) Atypical adamantinoma

Mixed tumors of salivary tissue in the mouth, as elsewhere are radioresistant.

Odontoma

Odontoma is a mixed tumor composed of ectodermal and mesodermal elements Strictly

speaking according to the classification given here that is, separating all tumors according to their origin from ectoderm or mesoderm the odontomas should be divided into three groups the simple ones composed only of one dental tissue mesoderm or ectoderm and the mixed or composite variety composed of both.

Mixed odontogenic tumors. These tumors contain both mesodermal and ectodermal elements There are soft and calcified mixed odontomas (composite odontomas) Calcium is not produced in the soft mixed odontoma either by enamel epithelium or by mesenchymal structures If both tissues grow slowly and are benign tumors are called *fibroadamantinoblastoma* more rapidly growing and malignant types of soft mixed odontomas take on sarcomatous appearances and are called *adamantinosarcoma* (Thoma)

Fibroadamantinoblastoma is a tumor in which the epithelial elements resemble adamantinomas (ameloblastomas) and the mesenchymal elements form fibrous tissue The epithelial elements come from the enamel organ epithelium and the fibromatous elements from mesenchymal portions of the tooth germ The symptoms are those of a slowly growing benign tumor forming a monocytic lesion Thoma states that tumors having preponderance of fibrous tissue are less likely to recur than when the adamantinoblastoma plays a more important role. Roentgen findings are those of a cystic lesion generally associated with an unerupted tooth Histologically the tumor is composed of collagen fibers and fibroblasts with epithelial strands proliferating in chains and buds and occasionally undifferentiated enamel organs.

Adamantinosarcoma is a rare malignant form of mixed dental tumors

Treatment The benign fibroadamantinoblastomas should be excised with a safe margin to prevent recurrence The malignant adamantinosarcoma requires the most radical procedure as does any other malignant tumor of the jaw Thoma recommends postoperative irradiation.



Fig 285

A. Geminated composite odontoma roentgenogram (late film)
B Cut specimen showing several well formed teeth fused together

Soft odontoma. According to Thoma, soft odontoma may develop from mature odontogenic tissue and is closely related to a central fibroma, or it may develop from immature odontogenic tissue and result in fibrosarcoma. These tumors are rare. Histologically they may be distinguished from true central fibroma by the fact that they usually contain epithelial structures. This puts them in the group of odontoma. Roentgen examination shows cystic areas containing tumor, demonstrating their relation to odontogenic cysts. Histologically the tumor is made up of collagen bundles and fibroblasts. Epithelium may be found proliferating in different parts of the tumor.

Odontogenic fibrosarcomas are malignant tumors and represent "the immature counterpart of the odontogenic fibroma," arising from the immature mesenchymal cells of the tooth germ. Their clinical history is like that of an infiltrating central fibrosarcoma. Roentgenological examination shows an osteolytic shadow with an indefinite outline, due to its infiltrating character. Histologically the tumor consists of immature mesenchymal cells. There are many mitotic figures.

The treatment of soft benign odontomas is surgical enucleation. Malignant tumors require radical resection of the jaw.

Calcified simple odontomas. Calcified simple odontomas may be identified as dentinomas, cementoblastomas, and multiple cementomas. These odontomas derive their particular characteristics from the specific type of odontogenic tissue from which they arise. Dentinomas are rare and are composed of dentine and soft tissue. In the roentgenograph calcification is noted surrounded by a radiolucent area of encapsulation. Microscopic examination shows a peripheral layer of cementum giving rise to irregular spicules of dentine, extending in radial fashion. In some instances, these have the shape of tooth roots with nutrient canals extending toward the center.

Calcified mixed or composite odontoma. Mixed odontomas are composed of mesenchymal and ectodermal elements and of calcified and uncalcified tooth tissues. They may be classified as (1) geminated composite odontomas when two or several more or less well-

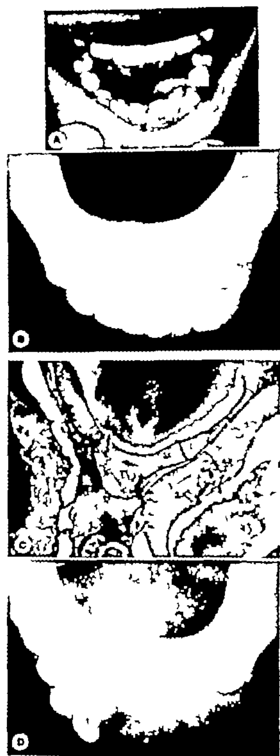


Fig. 286. Compound follicular odontoma.

A. Tumor presenting on lingual side of lower left jaw.
B. Bite film showing a large number of more or less rudimentary teeth.
C. Low power photomicrograph showing structure of tumor.
D. Bite film after operation. There is a moderate amount of defect left in the jaw after removal of the tumor. (Figures 285 and 286 loaned by Myron S. Aisenberg, Dept. of Pathology, Balto. College of Dental Surgery, Dental School, University of Maryland.)

formed teeth are fused together (Fig 285 A, B) (2) compound follicular odontomas, containing many more or less rudimentary teeth (Fig 286 A D) (3) complex composite odontoma in which the calcified elements are unlike the anatomic arrangement of dental tissue, (4) dilated odontomas in which the root or part of the tooth shows marked enlargement due to hollowing out of the middle portion (5) cystic odontoma in which the tumor is encapsulated by fibrous tissue containing a cyst or wall of a cyst These various types correspond to different stages in tooth development

Odontomas occur in any part of the mouth and in both upper and lower jaws. The main clinical indication as a rule is the absence of one or more teeth These tumors are benign in character and seldom give much disturbance, so that they often remain quiescent for years. Large tumors may produce expansion of the alveolus and asymmetry of the face They also prevent normal eruption and alignment of the teeth Thoma states that odontomas, like normal teeth, tend to erupt a process which may not become active until the neighboring teeth are extracted and the patient wears a plate.

Roentgen findings are of great importance because of the large amount of calcification in the tumor Early discovery by roentgen examination allows prompt removal and may prevent occlusal disturbance later The roentgen picture will vary according to the type of odontoma There are very dense irregular mottled shadows, evidence of the various types and stages of tooth development Such a tumor may or may not be in a cyst. Cystic odontomas can be differentiated from dentigerous cysts by the presence of poorly formed teeth whereas, in a dentigerous cyst the normal crown of a tooth is present The histological picture is that of a conglomeration of various types of tooth elements mixed in orderly or disorderly fashion Enamel dentine, cementum, soft tissue, such as enamel epithelium and periodontal tissue are found in the tumor

Treatment. Odontomas are benign and are excised by conservative surgical methods Recurrences have not been recorded

TUMORS OF MESODERMAL ORIGIN

Reaction to Injury

LOCALIZED OSTEITIS FIBROSA—WITH OR WITHOUT CYSTS

Localized areas of painless swellings in the mandible or maxilla and not caused by generalized disease (hyperparathyroidism) or derived from dental structures are not uncommon in the jaws. In these cases of localized osteitis fibrosa the serum calcium and plasma phosphorus are normal There is no generalized osteoporosis and if cysts are present they do not have epithelial lining as found in cysts of odontogenic origin. According to Thoma (1934) these lesions occur in patients less than twenty one years of age and more frequently under the age of fifteen years We have several patients who are older being in the third or fourth decade Geschickter and Copeland (1949) point out that the disease is probably preceded by a destructive process which becomes arrested or may progress without marked symptoms. At operation the bone destructive phase is almost complete or has been replaced entirely by the healing phase. In our cases in the older groups there was a history of onset associated with the extraction of teeth. It is difficult to obtain an accurate history of which came first, the swelling or the extraction of infected teeth If the latter came first it would seem that the osteitis fibrosa in the older group was due to an excessive reparative phase after the infection

According to Geschickter the more cellular growths occur in patients under the age of twenty years He agrees that they may be associated with infection or trauma or may arise spontaneously The clinical history is usually that of a painless swelling of the upper or lower jaw slowly increasing in size In our cases, the duration of the history varied from a few months in the younger age group to four or five years in the older patients The more cellular growths in the younger individuals may be termed *ossifying fibromas* In the older age group the adult bone becomes more compact and may be classed as *osteomas* (Geschickter)

The treatment is surgical removal Recurrence is not uncommon particularly if the

surgical removal has not extended beyond the pathological process and included some of the normal surrounding bone

Cysts may or may not be present. When present, the disease is termed *osteitis fibrosa cystica* Roentgenographs depict expansion of the bone, with or without radiolucent areas (cysts) (Fig. 287 A–C) The density of the tumor in the bone as seen in the x ray film varies between the density of normal cancellous bone, and normal cortical bone. The fibrous tissue intervening between the bone spicules makes the shadow less opaque than the solid cortical bone nearby There appears to be more bone, however in the tumor than in normal cancellous bone and therefore the shadow is more opaque than areas of normal cancellous bone in the same film

TRAUMATIC BONE CYST

Traumatic cysts are closely related to osteitis fibrosa cystica in their etiology, but deserve a special classification because of the different pathological picture In our one case (Fig 288) the patient gave a history of falling down and displacing the right central and lateral incisor teeth posteriorly several months prior to con sultation There was no particular swelling of the cheek at that time. In March of 1936 while under the care of W Buckey Clemson ortho



Fig 287 Localized osteitis fibrosa with cyst

A. Photograph of white female aged 11 with a lump on her jaw of six weeks duration.

B Roentgenogram showing cystic destruction of the anterior portion of the ramus of the jaw The edges of the radiolucent defect are not very regular on the other hand they do not show any motheaten appearance there is no bony reaction about the tumor

C Photomicrograph. Note the presence of a few bony trabeculations interspersed in an edematous fibrous matrix.

dontist a swelling suddenly developed in the right upper jaw. At that time she was wearing a brace to straighten the teeth displaced by the previous injury. This swelling appeared rather suddenly and was noticed by her sister as they sat at the dinner table. There was no pain and no discoloration of the cheek. On palpation the lump seemed more or less rounded, circumscribed, hard and about 2 cm. in diameter. It was attached to the bone but did not apparently enter the antrum as the antral wall could be felt distinct from the tumor with a groove between the two. There was definite swelling



Fig. 288. Traumatic cyst in a white girl, aged 12. (See text for details of history.)
A. Photograph before treatment.
B. Bite film taken in March, 1936.
C. Bite film taken in Dec., 1948. Treatment had consisted of draining the cyst, later it was curetted and the cyst wall removed, and still later she lost three teeth. Whereas there was asymmetry of the face in childhood this has been completely outgrown during the years.

of the right cheek just above and lateral to the nasolabial fold. There was no encroachment upon the floor of the nose.

The patient was treated by incision of the cyst and permanent drainage. Gradually the cyst reduced in size but did not entirely disappear. In the summer of 1937 she injured the cheek but there was little swelling as a result and in September 1938 under general anesthesia Conrad Inman (exodontist) opened the cyst and removed the entire lining. Pathological report was vascular granulation tissue and a mild amount of infection. The presence of *infection in this case* was probably due to the prolonged drainage prior to operation.

Pathogenesis. Thoma who quotes Schneider and Blum, feels that these cysts are due to trauma in soft bone where fracture does not occur. There is inter-osseous hemorrhage sometimes quite extensive due to the exceeding vascularity of the jaws. These cysts occur more commonly in the lower than in the upper jaw. The cortex is but rarely affected and generally not expanded.

Pathological examination. Blum (1932) quoted by Thoma finds that the thickness of the membrane varies in different parts. In some cases it is only thin, somewhat homogeneous and like endosteum. In Thoma's case he found a considerable thickness of fibrous granulation tissue lining the bony cavity.

Roentgen examination shows a cystic area of irregular outline. In our case the outline was fairly definite with a well-defined edge. The exact location of the cyst depends upon the point of injury. Roots of the teeth may be involved so that a differential diagnosis from radicular cysts must be made. Incision and currettage of the entire cyst wall followed by packing with suitable medicated gauze such as iodoform stimulates granulation and healing.

In our case which has been followed for thirteen years the patient has excellent recovery with normal occlusion lines. She lost one or two teeth by extraction after the cyst was removed (see Fig. 288 C).

Osteogenic Tumors

Osteogenic tumors in the jaw resemble osteogenic tumors in the other bones of the skeleton and are not common. Benign bone tumors are more frequently encountered than malignant bone tumors

Benign Osteogenic Tumors

HYPEROSTOSIS

This term is used to describe the enlargement of a part or all of the mandible or maxilla

EXOSTOSES AND ENOSTOSES

Exostoses are very common and occur most frequently at the insertion of the muscles and tendons (Thoma) or at the junction of two bones as the palatal processes of the maxilla In this location the term *torus palatinus* is given Torus palatinus (Fig 290) is common, occurring in the white race in about 9–12 per cent of normal individuals (Thoma) To the unaccustomed observer, the torus palatinus may be mistaken for a tumor requiring removal. As a matter of fact it is seldom neces-



Fig 289 Patient with hyperostosis occurring in Paget's disease
A and B Front and lateral views showing marked hypertrophy of the maxillae (Note that the nasal bones are not involved.) Patient white female aged 61

Such a hyperostosis occurs in Paget's disease (Fig 289 A–F) acromegaly and leontiasis ossea In these diseases, both jaws are usually affected. Local hyperostosis, which may occur unilaterally or involve only a portion of the maxilla or mandible, is thought by some to be due to inflammation or trauma In most of our cases there has been a history of the removal of teeth at the time of onset of the swelling of the jaw These swellings usually grow to a definite size and then stop Pain is seldom experienced.

sary to remove a torus palatinus unless the tumor is sufficiently large to interfere with an upper denture or becomes irritated repeatedly by eating Many theories have been advanced as to the origin of this tumor Horsley (1922) believes that the lobular type is an osteoma. The slow-growing character, without symptoms, would seem to favor this theory The tumor occurs at the junction of the two palatal bones and assumes various shapes. It may be flat or nodular spindle-shaped or lobular sessile or the edges may be overhanging

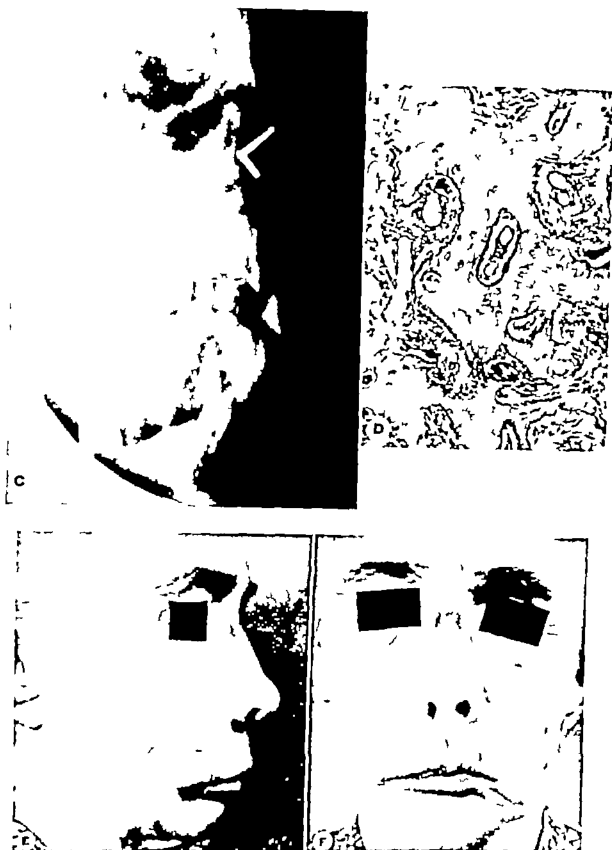


Fig. 289 (C–F)

C. Roentgenogram showing the irregular distribution of radiolucency and new bone formation.
D. Photomicrograph showing fibrosis between irregular bone spicules.
E and F are front and side views of patient after partial resection of the overgrown bone and plastic repair. Although no curative result is effected, the patient is able to close her mouth and eat and talk much better following the surgical procedures.

Roentgen examination reveals a radio-opaque dense shadow in the middle of the palate. The density is comparable to that of cortical bone. Histologically the picture varies with the size and shape of the osteoma Cortical portions are quite typical of adult cortical bone and should the tumor be very large a fair amount of spongiosa is observed

Treatment, if indicated consists of excision and closure of the mucous membrane over the raw surfaces. Following removal of large tori, *some of the redundant mucous membrane must be excised along with the tumor in order to give a good, smooth surface to the palate.*

An exostosis occurring on the mandible is called *torus mandibularis* (Fig 291) The tumor presents as a submucous, hard rounded or oval mass, fixed to the jaw and covered with normal mucous membrane usually on the lingual surface in the premolar region They rarely give symptoms and are often multiple One of our cases required removal because of the rather rapid growth The patient was a nurse in her upper thirties, who had not noticed the tumors until about six months before seeking medical attention. For fear that malignant change may have taken place, the tumor was removed Histological examination shows typical normal cortical bone with underlying spongiosa. Roentgen examination shows a radio-opaque shadow at the site of the tumor

Enostoses are hard bony growths, growing into the central portion of the jaw from the cortex Thoma differentiates these tumors from endosteoma by suggesting that in the former the tumor merges imperceptibly into the surrounding spongiosa whereas, the latter are more likely to be demarcated by a connective tissue capsule which is seen as a dark line separating the ingrowth from the spongiosa. In our series of bone tumors of the jaws all of these exostoses and enostoses were described as osteomas, because of the histological picture In the roentgenographs, *enostoses appear as dense radio-opaque shadows within the jaw*

OSTEOMA

Osteomas occur on the jaws as in other bones of the skeleton They may be peripheral *or central in location, that is, may occur on the surface of the jaws or in the center of the jaws.*



Fig 290 Torus palatinus or exostosis of the palatal bones *in the midline*



Fig. 291 Exostoses on the lingual side of the mandible (Torus mandibularis)

The latter are sometimes spoken of as *endosteal osteoma*

Pathogenesis Thoma suggests that the development may occur from any part of the

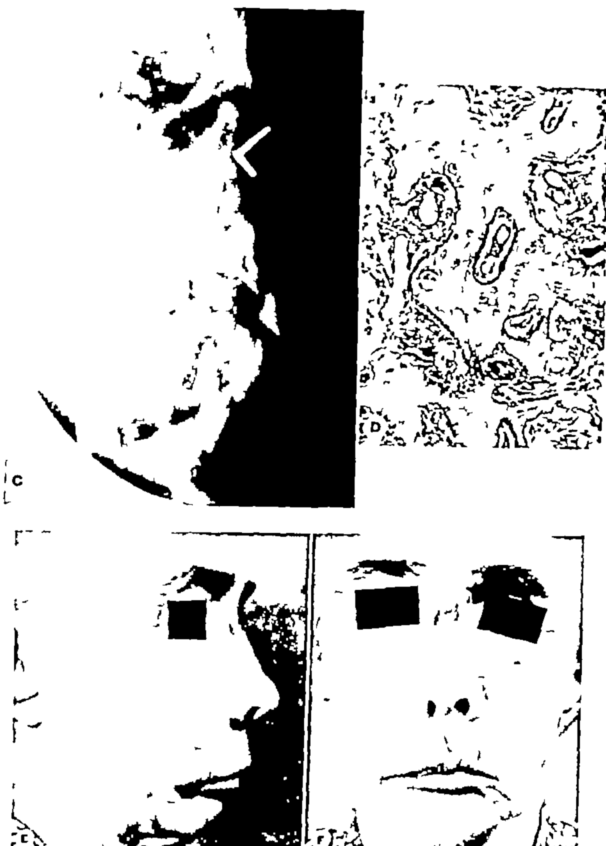


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Pathogenesis Thoma suggests that the development may occur from any part of the

maxilla or mandible and arises from pre formed bone periosteum or retained cartilage cells from the embryonic chondro-skeleton These tumors are benign in character and grow slowly After the termination of the general skeleton growth the local growth ceases

Clinical signs The symptoms of osteoma are due to the mechanics caused by the size of the growth Small ones may remain unnoticed for an indefinite period. They usually do not give much pain Depending upon location and size when inside the mouth they cause disturbances in mastication, breathing, and swallowing

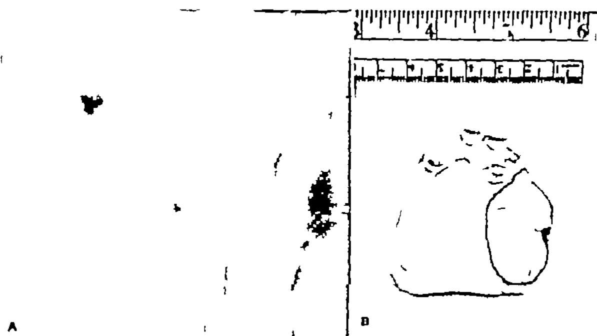


Fig. 292 Osteoma of the maxilla (Note the dense shadow cast by the cortical like bone
A Roentgenogram.
B Plaster cast showing extent of the osteoma outlined by the black line

Large osteomas cause marked disfigurement of the patient's face Osteomas are hard circumscribed and often irregular in shape although they may be rounded and smooth They may be sessile or attached to the cortex by a pedicle If endosteal there may be swelling of the jaw and the true nature of the tumor determined by roentgenographs and finally by histological examination Osteomas in the maxilla may involve the tuberosity or occur within the antrum itself (Fig 292 A and B)

In the 196 cases of tumors of the jaws in our study there were seventeen osteomas varying in age from eleven to sixty Thirteen occurred from the ages of thirty-one to fifty There were five males and twelve females affected. The symptoms were pain in two swelling in two pain and swelling in thirteen (eight of which had disability) and in three there was an unerupted tooth associated with the tumor On examination four were found to involve the upper jaw thirteen the lower jaw One was located centrally sixteen peripherally fourteen being on the lingual side and two on the buccal side of the jaw Three were associated with ulceration three occurred on the left side and fourteen on the right side In this group thirteen had had previous treatment consisting of surgery in six x rays in one curettement in four and tooth extraction in two

Treatment consisted of tooth extraction combined with surgical removal in one curettement in one conservative surgical removal in nine and radical surgical removal in seven Five required plastic procedures for reconstruction Nine of these cases were followed three for two years and five for seven years and found to be well One had a recurrence after three years

Fibrous Osteoma. This benign osteogenic tumor has been variously described in the medical literature under a number of terms localized osteitis fibrosa localized osteodystrophia ossifying fibroma fibrous osteoma osteofibroma, hypertrophic localized osteitis, and osteoid osteoma The terms *osteitis fibrosa* and *hypertrophic localized osteitis* naturally imply the association of infection or at least inflammation In this tumor there is no evidence of inflammation These tumors also have a varying proportion of soft and bone tissue. They are not well-circumscribed, their growth as a rule extending irregularly into the surrounding bone. Thoma (1934) formerly called these tumors *localized osteitis fibrosa* He bases his contention on the fact that there is no evidence of inflammation or infection and that this condition occurs in many patients without indication of other general bone disease, such as Paget's disease. Phemister and Grimson (1937) use the term *fibrous osteoma*, which expresses a similar pathological process. These authors consider this condition related to membranous pre-formed bone as benign cartilage tumors and exostoses as related to cartilage pre formed bone

This view is substantiated by the tendency of fibrous osteomas to begin in childhood and to grow slightly or not at all in adult life, as is the case with cartilage exostoses When these tumors start in childhood they tend to become stationary in adult life The more mature tumors with extensive ossification are probably better called *fibrous osteoma*, while those in which fibrous tissue and immature bone predominate are probably better called *osteofibroma* or *ossifying fibroma*

Phemister and Grimson further state that at the time of their study no case had been reported in the literature which had become malignant One of our cases recurred after three years

We agree with these authors and oth



Fig 293 White male aged 18 complaining of a lump in the left mandible of 2 years duration

A. Photograph showing osteomas on both mandibles.

B Roentgenogram revealing several osteoblastic tumors of the facial bones, ethmoid sinuses, left mandible and were interpreted as osteochondromata or ossified fibromata. The long bones were negative. The osteomata of the bones of the face are somewhat fluffy and of a motheaten density Nearly all of the bones of the face are involved Skeletal survey showed no evidence of lesions elsewhere. Treatment surgical excision. Histological examination of tissue removed showed the presence of normal bone for the most part and a few areas of osteoporosis. The appearances do not suggest tumor "

It is interesting that this boy's father and mother also had multiple osteomas none of the other children had similar lesions

these lesions appear to be true neoplasms and differ from osteitis fibrosa, or chronic inflammation which follow an injury or extraction of infected teeth. *Admittedly it is difficult in some* cases to prove whether the teeth appeared to be infected (loosened) as a result of the bone lesion or whether the "infected teeth" preceded the bone lesion.

Blood calcium and phosphorous determinations are normal in fibrous osteoma and osteitis fibrosa.

Histopathology. Those who look upon this disease as osteitis fibrosa base their conclusions on traumatic or inflammatory etiology, as many of these cases give a history of trauma, extraction of carious teeth or other infection. Not all of our cases have had such a history; as a matter of fact three of our cases which occurred in the maxilla began with painless swellings in the cheek and without history of trauma or infection. Microscopically one sees a mixture of fibrous tissue and new bone trabeculae. *The proportions of these two tissues* vary with different tumors so that the terms *ossifying fibroma*, *fibro-osteoma* and *fibroid osteoid osteoma* describe the varying histological pictures. One of our cases was previously diagnosed as *fibrosarcoma* after biopsy. There were no mitotic figures and clinically the patient did not show the usual picture of rapidly growing malignant disease. Although we have seen no cases in which malignancy developed, yet these patients should be carefully watched for several years.

Clinical findings. These tumors produce a varying degree of facial deformity, depending upon their location and size. Most commonly this is the symptom which brings them to the physician. In our series of 196 tumors of the jaws there were nine cases diagnosed as fibrous osteoma. Their ages varied as follows:

Under 10 years	1
11-20 years	4
21-40 years	2
51-60 years	2

Females were more commonly affected than males. The average duration of symptoms was five and a half years. Pain and swelling were the most common symptoms, swelling alone occurring in three. In two there was disability of jaw function and each of these had both pain and swelling. Four occurred in the upper jaw and five in the lower jaw. Six were located centrally in the bone and three peripherally. Two of the peripheral lesions were on the lingual side of the jaw and one on the buccal. Three occurred on the right side and seven on the left; one case occurred at the symphysis, and so presented on both sides. Some of these cases were recurrent after previous therapy. In four the therapy consisted of tooth extraction only, one had curettement and one surgical removal.

Roentgenographic Findings. Occasionally these tumors appear as a circumscribed area of radio-opacity of varying density (Fig. 294 A-D). The opacity is greater as the proportion of bone tissue is greater. Where fibrosis predominates the radio-opacity is lessened. In most cases the changes are diffuse without a definite line of demarcation. There is no periosteal bone formation. In fibrous osteoma there are no well-defined cystic areas, as seen in osteitis fibrosa cystica or in odontogenic cystic tumors. The usual density in the x ray lies between the density of the cancellous bone on the one hand and of cortical bone on the other. The presence of an increased amount of bone makes the shadow more dense than normal cancellous bone and the presence of a larger amount of fibrous tissue makes the shadow less dense than in normal cortical bone.

Treatment. Small tumors are resected in a line of surrounding normal bone, usually sufficing to eradicate the disease. Extensive resections may require plastic procedures. Fibrous osteomas involving the maxilla are treated by a combination of surgery and intra-antral application of radium. This procedure was suggested to us several years ago by Murray M. Copeland who was working in our clinic at the time. The antrum is opened through the mouth lateral to the alveolar margin. Sufficient tissue is removed for adequate histological study and a cavity is hollowed out to admit the radium



Fig. 294 Fibrous osteoma of the maxilla in a white boy aged 15

A. Roentgenogram taken prior to treatment in December 1944 Note involvement of all of the walls of the antrum The upper surface of the orbital plate is still quite smooth. The shadow filling the antrum is of the density of cancellous bone indicating that there is both fibrous tissue and osseous tissue in the tumor The shadow is less dense than the cortical bone nearby Before being referred to us x ray therapy consisting of 4400 r distributed through three portals, was given to the right antrum. In January 1945 470 mg hr were given in the nose filtration 1 mm. Pl. On January 30 1945, under general anesthesia the antrum was opened through the mouth and 11 needles, each containing 2 mg radium element, were forced up into the antrum. Sufficient tissue was taken at the same time for biopsy The tumor was so vascular that it was impossible to hollow out the growth sufficiently to insert radium tubes. A total of 1800 mg. hr was given.

B Roentgenogram taken Oct. 6, 1947 shows further regression of the tumor in the antrum. Note that the orbital floor is thickening and becoming more normal. This patient is still under observation Small bits of sequestrum are curetted out of the antrum from time to time through the sinus which persists in the floor of the antrum

C. Roentgenogram April 27 1949, improvement continuing

D Photomicrograph showing typical picture of fibrous osteoma.

tubes. In one of our cases, the bleeding was so brisk that it was inadvisable to remove much tissue consequently radium element needles were inserted into the spongy bone (Fig 294) The average dose of intra-antral radiation has been between 1500-1800 mg hr Sometimes this is coupled with external irradiation by x ray

Three patients treated as above are free of active disease, nine, eight and four years, respectively The last still has a persistent sinus from antrum into mouth from which bone

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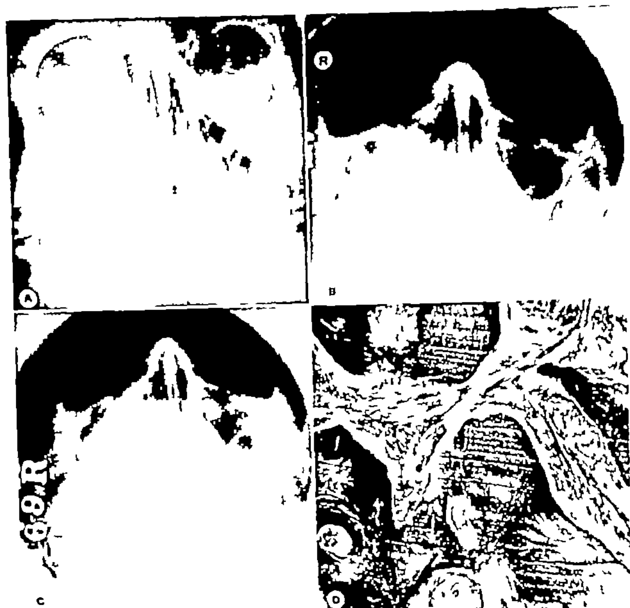


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spicules are removed from time to time (Fig 294)

The patient whose roentgenographs are shown in Figure 295 A and B is a young woman seen in consultation with Burdelle Cannon and J H Mason Knox III at Church Home Hospital in 1941, age of seventeen years with a painless and gradually enlarging swelling of the right cheek of six months duration. Roentgenographs showed a rather dense shadow suggestive of fibrous osteoma filling the antrum and extending up and out into the malar bone and zygoma. At operation 3/18/41 the antrum was opened through the mouth lateral to the alveolar process and tissue removed for diagnosis Report on frozen section was covered with mucous membrane, and a fistula from the mouth into the antrum She was referred to her dentist.

Patient is in good health now with only slight flatness of the right cheek corrected by a small prosthesis. Her surgeon, J H Mason Knox, III wrote on June 2, 1949 that the patient "has pain in right antrum and maxilla during cold months. There is also some numbness at the corner of the upper lip on right side. She has had some mucus discharge, occasionally blood-tinged, from the operative pocket. She no longer wears the prosthesis and irrigates the cavity with Dobell's solution at least once a day" The cavity is lined with mucous membrane. The patient is four months' pregnant.

Roentgenographic report by William Pierson "There is some thickening of the walls of the right antrum, but the bones are intact and the antrum is clear All the sinuses are clear" (Fig. 295 B)



Fig 295 Fibrous osteoma, maxilla white female 17 years of age

A Roentgenogram showing almost complete obliteration of right antrum by bone producing tumor similar to that in 294 A

B Roentgenogram 8 years after treatment There is some thickening of the walls of the right antrum but the bones are intact and the antrum is clear—all sinuses are clear (See text for details of treatment.)

periosteal fibrosarcoma consequently a larger dose of radium was given than for a benign growth A large cavity was rongeured out of the spongy bone filling the antrum Eighty milligrams of radium element contained in four platinum-iridium tubes, placed in rubber cots, were distributed throughout the cavity and held with vaseline gauze packing for nineteen hours, giving a dose of 1520 mg hr Pathological diagnosis from permanent section was fibrous osteoma

Convalescence was uneventful Five months later she returned because of some discomfort in the right cheek for the past week The only pain has been an occasional stabbing pain Examination was negative except for an erupting right lower third molar tooth

CHONDROMA AND OSTEOCHONDROMA

Cartilaginous tumors of the jaws are rare.

Pathogenesis. Cartilage-containing tumors of the jaws are of embryonic origin, arising from retained cartilage of the fetal chondroskeleton (See Chapt II embryology) Chondromas and osteochrondromas occur more frequently in bones with pre-osseous cartilage formation In the mandible the cartilaginous

rests are the result of incomplete absorption of Meckel s cartilage or in the symphysis where the accessoary 'symphyseal cartilage takes part in the formation of os mentis Osteochondromas may also occur on the coronoid process and the chondyle of the mandible.

In the maxilla cartilage tumors arise from embryonic rests of the alveolomalar process, Reichert s cartilage, periseptal cartilage and the ethmoid

Histology Chondromas are made up of cartilage tissues There may be associated lymphomatous changes when the tumor tends to grow more rapidly and shows greater tendency to malignant change (Chondromyxosarcoma), osteoid and true areas of bone may be seen

Clinical behavior Symptoms are pain and swelling and disability depending upon the location If the tumors are large, there will be disfigurement In all seven of our cases, pain and swelling was the predominating feature there was disability in two and loos teeth in two The average duration of symptoms was two years. The ages varied from twenty-one to fifty years two occurring in the decade between twenty-one and thirty two from thirty one to forty and three from forty-one to fifty There were four males and three females. Six occurred on the upper jaw, one on the lower jaw Two had central locations and five peripheral (lingual) locations One was on the left side six on the right There was associated ulceration in two cases All seven had been previously treated four by tooth extraction and three by surgical excision

Roentgenographic findings. On account of the small amount of osseous tissue, true chondromas are usually radiolucent. The presence of bone tissue in the tumor casts a peculiar spotted shadow in the x ray film The absence of periosteal reaction indicates their benign character Large growths obscure the normal surrounding landmarks.



Fig. 296. Osteochondroma of the mandible.

A. "The posterio-anterior projections show lateral expansion of the coronoid process of the mandible and erosion of the inner surface of the zygomatic arch."

B Photomicrograph showing the gradual change from fibrous tissue to cartilage and to bone.

Treatment is surgical excision, including a zone of the normal surrounding bone Four of our cases were followed one for one year, two for three years one for five years without recurrence. The danger of chondroma becoming malignant is illustrated by patient shown in Fig 301 302.

Shackelford and Brown have recorded four cases of osteochondroma involving the coronoid process of the mandible, giving rise to restricted jaw motion (Fig 296–298) The main symptom in these cases was painless, progressive limitation of motion of the jaw All had

swelling of the face over the involved bone or expansion of the zygomatic arch One gave a history of injury This patient together with another had the symptoms of a cracking sensation in the jaw when the mouth was opened or closed. The diagnosis in each case had been obscure for from two to five years

Diagnosis was made only after roentgenograms were taken with the central ray directed tangentially to the cheek of the affected side instead of being centered on the midline of the chin. The anteroposterior position usually employed demonstrating the nasal sinuses may also give a good view of this lesion



Fig 297

A. Depicts expansion of the coronoid process and erosion of the zygomatic arch In order to obtain this view it is necessary that the patient's head be partly rotated and the rays directed tangentially to the side of the head. The exact amount of angulation can be estimated after the taking of scout films and fluoroscopic examinations of the head and face This projection produces some distortion but does supply the maximum amount of detail

B "Examination made with the patient in the special position shows that the coronoid process has been removed and the zygomatic arch has been restored Post operative

"The first three patients studied were reported by the pathologist as having typical osteochondroma with a stalk of bone capped by a mushroom like head of cartilage (Fig 296 B) They were located at the site of attachment of the tendon supplying traction at that point namely the tendon of the temporal muscle In these three cases there was no history of previous in that the tumor was osseous rather than osteochondroma

"It arose from the zygoma instead of the coronoid and followed a definite history of trauma with roentgenographic evidence of previous fracture of the zygoma."

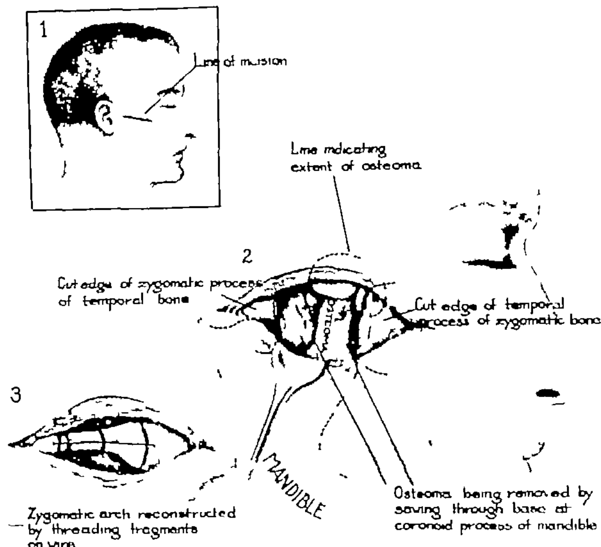


Fig 298. Steps in surgical removal of osteochondroma of the coronoid process. (Figures 296–298 are reproduced by permission of Surgery Gynecology and Obstetrics, and R. T Shackelford and W H Brown.)

trauma and the explanation offered is the same as that for osteochondroma in other parts of the body where it commonly occurs at the sites of tendonous insertions. Such characteristic locations are believed to be due to a defect in the periosteum at these points, permitting precartilaginous blastomata to escape or be pulled from the limiting membrane and in time these cells produce an osteoma."

Their fourth case differed from the others However it was included in their study because its impingement on the coronoid process caused the same symptoms of progressive limitation of motion of the jaw as did the osteochondromas of the coronoid process

Treatment consisted of surgical removal of the growth. The operative procedure is illustrated in Figure 298 An incision is made over

the zygomatic arch which is then resected. The zygoma is saved and replaced by wiring as a free graft The coronoid process, together with the connected tumor is dissected free of all soft parts and muscle attachments and then removed by sawing through the base with a Gigli saw In the case where the osteoma came from the zygomatic process, no attempt was made to replace the zygoma.

The authors emphasize that injury to the facial nerve can be avoided by making a skin incision superior and parallel to the inferior edge of the zygoma.

Ivy (1927) reported three cases of benign bony enlargement of the condyloid process of the mandible and referred to several others recorded in the literature.

In summarizing his three cases Ivy emphasizes that the bony enlargements of condyloid process present a definite clinical syndrome of slowly progressive vertical elongation of one side of the face due to the lengthening of the ascending ramus of the mandible. The chin is pushed over to the opposite side, resulting in failure of the upper and lower teeth on the affected side to meet. Interestingly enough, there is little or no interference with motion of the jaw In his third case, this syndrome was not accurately followed there being some limitation in opening the jaw caused by pain on movement. On physical examination, there is visible enlargement beneath the zygoma, some tenderness, but no definite mass felt on palpation.

Roentgenographs showed a well-defined A P enlargement of the condyle, with smooth margins.

Treatment was removal of the condyle through a Blair incision. Recovery was satisfactory in all cases.

In the one atypical case showing some pain on motion the condyle contained a cavity filled with blood and marrow clinically a bone cyst. *Histologically there was no evidence of* abnormal bone, only hemorrhage on the surface of the cavity There were no giant cells or tumor cells. The other two cases showed perfectly normal hypertrophy of bone and cartilage. Ivy states that up to that time no case of bone cyst limited to the condyloid process of the mandible was reported in the literature. He refers to Eckers (1899) Scudder Perthes (1907) and Gruca and Meisels (1926) who have reported similar cases

CENTRAL GIANT CELL TUMORS

In our study of 196 cases of tumors of the jaws there were sixty two diagnosed as giant cell epuli. Three of these were central and fifty nine peripheral. Central giant cell tumors are uncommon in the jaws. Geschickter (1935) reported twenty five cases in a total review of 333 tumors of the jaws. The lower jaw is more frequently involved than the upper and, like the peripheral giant cell tumor the central giant cell tumor occurs usually in young adults. This is in contrast to giant cell tumors of long bones, which are more common after the age of twenty five years.

Pathogenesis. Geschickter and Copeland have shown that giant cell tumors of the jaws are associated in their origin with those areas of bone development through the intermediary of cartilaginous ossification The giant cell tumors in the mandible apparently arise from embryonic rest of Meckel s cartilage. The tumors in the antrum, orbits, and upper jaw arise from the ethmoids, turbinates, and sphenoids which ossify through cartilage These authors point out that there is a similarity in the origin of giant cell epuli from the pericementum and central giant cell epuli from the resorption of temporary calcified structures deeper in the jaws. Those within the jaws arise from giant cell osteoclasts, just as the peripheral epuli arise from giant cell odontoclasts.

Histology As in the giant cell peripheral epulis these tumors viewed under the microscope are seen to be made up of multinucleated giant cells in a stroma of round and spindle-shaped cells.

Clinical signs. Central giant cell tumors grow more rapidly and destroy bone more extensively than the peripheral epulis. The average duration of Geschickter s series was seven months There is expansion of the mandible

to a thin shell of bone The mucous membrane may be discolored to a dark purplish hue if the tumor is vascular and most of these tumors are vascular

Roentgen examination shows a central, radiolucent, single or multiloculated expansion of bone with a thin shell (Fig 299) Central trabeculations vary in size and often extend throughout the tumor The x ray picture is not unlike that of a single or multilocular benign cyst and often differentiation is established only by histological examination

Central giant cell tumors, at operation, appear friable and hemorrhagic indeed, they are so hemorrhagic as to simulate hemangioma the differential diagnosis being made by frozen or permanent sections.

Treatment of central giant cell tumor is conservative. In years past it was thought that radical resection of the jaw and involved teeth was necessary (Halsted) With present methods of electrosurgical and chemical cauterization and radiation conservatism is the rule. Good results have been obtained by electrosurgical removal and coagulation of the remaining cavity In this way we have been able to remove large giant cell tumors and save some of the residual teeth (Fig 312) In one young adult, the two involved teeth upper left lateral incisor and canine were preserved for at least twelve years, through which we followed the patient When the tumors are in the mandible or in the upper alveolar arch and have not extended high into the maxilla such conservatism without radiation is preferable. When the tumors extend into the temporal fossa or high into the maxilla, local removal should be followed by irradiation, as it is impossible to resect such extensive growths.

Malignant Osteogenic Tumors

OSTEOGENIC SARCOMA

Malignant bone tumors of the jaws are fortunately very rare as evidenced by the fact that in our 196 cases recently studied there was one osteogenic sarcoma two osteochondrosarcomas and two myxochondrosarcomas Coley (1949) states that in an eighteen year period of Memorial Hospital, only thirty five histologically confirmed cases were seen on the head and neck service Theoretically, any kind of malignant bone tumor might develop in the jaw, as well as in any other bone of the skeleton Because of the possible development of fibrosarcoma from central fibromas of the jaw and also because they may arise from soft odontomas, we discussed fibrosarcoma under the heading of connective tissue tumors

Clinical Behavior Since the clinical signs of the various forms of osteogenic sarcoma are similar they all will be discussed in one group Pain swelling and disturbance of mastication are the usual symptoms, varying in duration from one month to two or three years Males and females are about equally affected The average age in Coley's series was thirty-six In our cases, the ages varied from twenty-six to fifty two years.



Fig 299 Central giant cell tumor of the maxilla. Roentgenogram. The tumor has expanded and thinned the cortex and displaced adjacent teeth. Note complete bony septa characteristic of giant cell tumor as seen in other locations. Patient, white male, aged 8.

Roentgenographic findings suggest the possibility of malignant tumor (Fig. 300 A) The amount of radio-opacity will depend upon the amount of new bone laid down and the amount of bone destroyed. Chondrosarcomas and myxochondrosarcomas may not show much new bone formation The radial spicules of bone laid down by osteogenic sarcoma *(sunray ef*

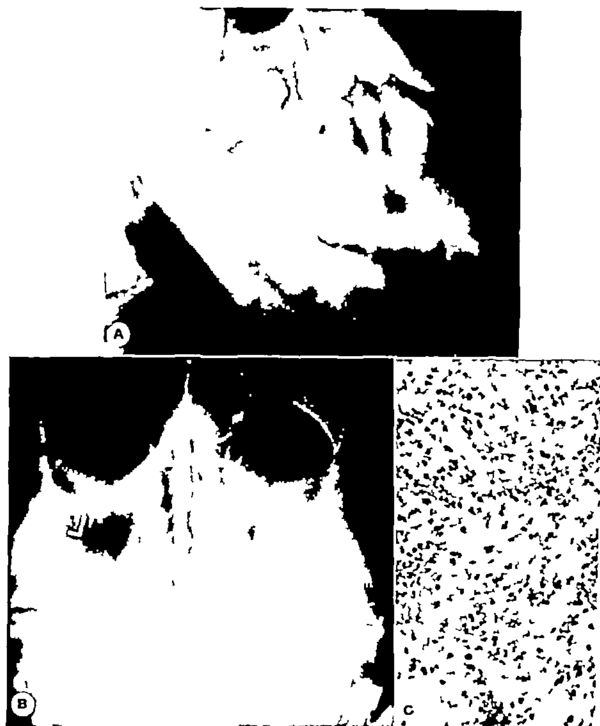


Fig 300

A. Roentgenogram of osteogenic sarcoma involving mandible (Note the mottled destruction of bone There is some suggestion of new bone formation along the lower border of the left side of the mandible This patient had had x-ray therapy before being admitted which confused the picture The typical radiating spicules of bone laid down by osteogenic sarcoma are not present in this case

B Fibrochondromyxosarcoma in a white male, aged 12 complaining of swelling in the right cheek six weeks before admission *Patient unable to open his mouth more than about 2 cm Directly beneath the ramus of the* mandible on the right side were several, enlarged rather firm nodes It was impossible to get an accurate biopsy because of slough and inability to open the mouth. Patient was started on x ray therapy The lesion did not progress following radiation therapy until 10 months later when he was re admitted and pathological examination showed fibrochondromyxosarcoma Roentgenogram shows a mass of slightly greater density than normal soft tissue arising from the right maxilla and alveolar area. There is destruction from without of the lateral antral wall. No evidence of calcification within the tumor

C Photomicrograph showing very anaplastic fibrochondromyxosarcoma.

fect) are not always present in osteogenic sarcomas of the jaws (Fig 300 B and C)

Diagnosis is made finally by biopsy (Fig 300 C, 302, A,B)

Treatment. Before the advent of radiation therapy surgery was the sole method of treatment In the last two or three decades radiation alone or in a combination with surgery, has been used rather extensively Since bone sarcomas, as a rule, are radioresistant we feel that the method of choice is radical surgical resection of the jaw containing the tumor with as wide margin of safety as possible. Following intensive radiation therapy complications of radio-osteo-necrosis, marked soft part destruction with dense sclerosis infection and subsequent severe hemorrhages only serve to complicate the picture

Prognosis. The ultimate results in the treatment of osteogenic sarcomas of the jaws is not good The best results of course are obtained in the earlier cases, when aggressive surgical procedures may help the patient to survive. The prognosis is also dependent upon the histological character of the tumor In a series of twenty two cases carefully followed and reported by Coley the five year survival rate based on the determinate group was 33⅓ per cent In our few cases, the patients only lived from six months to two years after diagnosis was made



Fig. 301 White male 52 years of age, with extensive osteochondrosarcoma of the maxilla, bilateral. Patient gave a history of having a growth removed from the upper alveolar process two years previously diagnosed chondroma. Recurrence was rather prompt. Growth slow and steady with disfigurement.
A and B Front and side views showing distortion of the maxilla from the growth.

Connective Tissue Tumors

We have chosen to divide the mesenchymal tumors of the jaws into those arising from bone and from connective tissue of a non-osteogenic type. This latter group includes cementoblastomas, central fibroblastomas, both benign central fibroma and fibrosarcomas fibromyxoma, central neurogenic tumors, central angiomas, Ewing s tumors, multiple myeloma and eosinophilic granuloma The last three are discussed in Chapter XX with tumors of the bones of the head.

CEMENTOBLASTOMAS CEMENTOMA (PERIAPICAL FIBROMA)

These are fairly common tumors. The cementum is formed by a cellular stroma the active and primary part of the neoplasm During the growing stage the cellular part predominates and, at a later stage, completion of growth may be reached when cellular activity stops. There remains a thin connective tissue capsule around the calcified cementum (Fig 303 and 304 A–E, and 305) Thoma suggests the word *cementoblastoma* in place of cementoma

Stafne (1934) has traced the development of cementomas or cementoblastomas from masses of connective tissue at the root ends of vital normal teeth as a result of proliferation of connective tissue of the peridental membrane Since cementoblastomas are frequently multiple and remain rather indefinitely as a translucent area when viewed in the roentgenograph and could be confused with a dental granuloma or cyst we emphasize them here for the sake of differential diagnosis from multiple follicular or radicular cysts. When the diagnosis of cementoblastoma is made, the teeth may be saved whereas, they would be extracted if there were multiple granulomas or cysts Stafne states that in a study of microscopic sections obtained in several cases and by roentgenographic examination made in others during the course of development of the neoplasm, it was noted that in most instances cementicles formed in the connective tissue to such an extent that cementum almost completely replaced it. The result was a mass of radio-opaque cementum that remained separated from the surrounding bone by a layer of connective tissue The translucent layer of connective tissue around it produced on the roentgenogram an image so characteristic

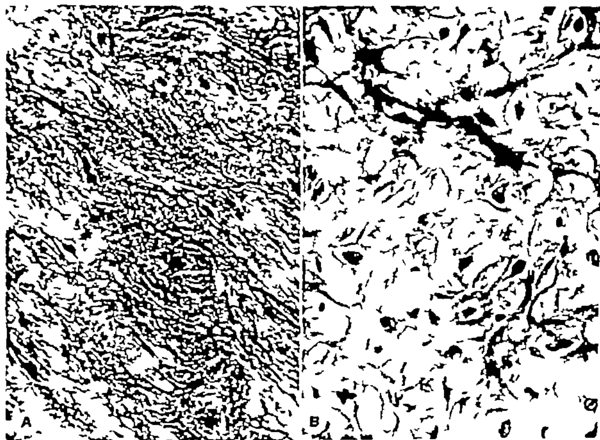


Fig. 302

A and B Photomicrographs showing malignant chondromatous growth. It is interesting to note that this patient had widespread cervical metastases before death. Same patient illustrated in Fig 301 (Patient in Veterans Administration Hosp Perry Point Md Courtesy Dr Richard T Shackelford.)

that a reliable diagnosis could be made readily from the roentgenographic evidence. A com

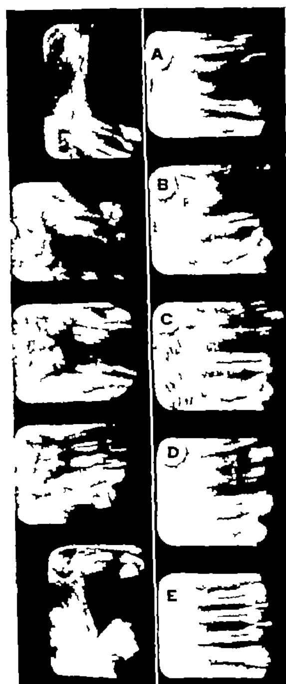


Fig. 303 Fig. 304

Fig 303 Illustrates multiple occurrence of cementoma on teeth of lower jaw

Fig 304 Steps in the development and resorption of periapical fibroma on lower right lateral incisor

A. Nov 1 1948
B Mar 21 1935
C Jan 4 1937
D Dec. 21 193
E. Dec. 2 1940.

mon feature was the tendency for the lesion to appear about several teeth in the same person The multiple occurrence of cementoma is shown in Figures 303 and 304

Roentgenographic examination is quite diagnostic although the tumor is not uniform in all stages of development and the radio-opacity of the tumor varies with its histological structure Thoma discusses the radiological pictures according to the three stages

1 The osteolytic stage represents the immature cementoma which is composed of cellular tissue and contains no calcium There is bone destruction and consequently a radiolucency which appears dark in the x ray As has been mentioned above Stafne calls attention to the similarity of these tumors in the x ray to a granuloma or small radicular cyst Thoma states that differential diagnosis can be estab-



Fig 305 Photomicrograph of cementoma with cementicles fully developed

(Figs. 303 304, 305 Courtesy of Edw C. Stafne and Jour Amer Med Assn)

lished only if the related tooth is normal and if there is no question of pus or periapical infection

2 The cementoblastic stage is associated with the beginning of the formation of cementum in the tumor Formerly this stage was called a calcified granuloma since the cementum contains calcium which is beginning to be deposited in the tumor There is a dark area around the centrally located radio-opaque calcification and surrounding this darker is a white area of condensed bone.

3 The mature inactive stage, when calcification is complete but there is still a thin dark area around it indicating the soft part is now merely a remnant of inactive tissue Several investigators (Stafne, Thoma Aisenberg Personal communication) have observed no change

in the mature cementoma over a period of years. Evidently the tumor reaches an inactive stage and remains stationary (See Fig 304) Stafne states that after formation of the original fibrous mass, further development may follow one of three courses (1) Most of the fibrous mass may be converted into cementum (2) it may remain as a cementoblastoma or fibroma for an indefinite period, or (3) it may be replaced by bone" The formation of cementicles (Fig 305) and later bone, indicates that both osteoblasts and cementoblasts take part in the tumor formation The histological picture naturally will change with the period of the development of the tumor In the early young tumors, the stroma is made up of young fibroblasts, collagen fibers and a few blood vessels, resembling the early peridental membrane of the tooth Gradually cementicles form in increasing numbers and size, and fuse into a solid mass Trabeculae may appear presenting a calcified osteoid appearance distinguished from bone by the concentric arrangement of the trabeculae (Thoma) and by the granular and irregular calcification of the tissue and the shape of the cement corpuscles in lacunae which are similar to those found in the osteo-cementum of the tooth

Treatment is surgical removal when the tumors become large In most cases, no treatment is indicated for the tumors are slow in growing and become stationary and apparently remain innocuous for an indefinite period Thoma states that when The tumor is large, containing a great deal of fibrous tissue, I should advise operation, particularly if there is expansion of the bone and facial disfigurement.

FIBROMA (CENTRAL FIBROMAS)

These tumors are rare In our series of 196 cases of tumors of the jaws, there were nine fibromas three of which were centrally located Thoma states that central fibromas are not easily recognized because they give no symptoms Kegel (1931) reported that there were only six verified examples in the Surgical Pathological Laboratory of the Johns Hopkins Hospital up to that time The main symptom is swelling rarely pain. The tumor is more common in the mandible than in the maxilla and grows slowly and gradually from one to fifteen years. The lack of a crackling sound when compressed differentiates the tumor from a cyst

Roentgenographic findings. Although various authors have classified central fibroma as an osteolytic lesion with well-defined margins and not trabeculated one of our cases, which is reported under Fibrosarcoma' was originally diagnosed six years earlier as benign central fibroma (See Fig 308 A) The x ray picture was that of a very diffuse ill-defined lesion with greater density than the surrounding bone

An odontogenic central fibroma, which usually has a cystic formation and is closely related to a tooth must be differentiated from ordinary central fibroma

Pathogenesis. This tumor may be formed from residual embryonic connective tissue or the connective tissue of the tooth germ or perineural sheath.

Coley calls attention to the origin of peripheral fibromas from the periosteum of the jaw as in other bones.

Histology The tumor is characteristic of a fibroma containing fibroblasts and collagen fiber bundles Those arising from tooth germs of the soft odontoma type contain epithelial structures and belong in another group Fibromas may undergo calcification and present a picture simulating fibrous osteoma. In the benign cases there is absence of mitotic figures which differentiates it from fibrosarcoma.

Treatment. Although the treatment of central fibroma is usually conservative, consisting of enucleation and chemical cauterization or treatment with electrosurgery one must be on the lookout for possible recurrences and later development of fibrosarcoma as illustrated in the case shown in Figure 308

The ages of patients having benign fibroma both central and peripheral in our series varied from eleven to sixty years

There were eight females and one male Only one case had pain alone as the presenting

symptom Eight complained of pain and swelling and eight had disability due to the swelling Five occurred in the upper jaw four in the lower jaw three on the right side and six on the left. There were two central fibromas The six peripheral fibromas all occurred on the lingual side of the jaws There was ulceration in four cases Previous treatment consisted of tooth extraction, curettage, x ray and surgery Treatment in our clinic was radical surgery in six, and local resection in three cases. Two had x ray therapy and two required plastic procedures Of this group of nine cases, three were followed two years and three for five years without recurrence. One case recurred seven years later as fibrosarcoma, and died.

FIBROMYXOMA

Fibromyxoma are placed under true osteogenic tumors by Thoma Although they may occur in the maxilla and mandible in our two patients both were in the mandible, one on the right side and the other on the left As indicated by the paucity of literature on fibromyxomas of the jaw, one would conclude that they are rare tumors

Pathogenesis If they develop from osteogenic tissue, then they must arise from very early embryonic cells still in the preskeletal form Both of our cases were in young women seventeen and nineteen years of age.

Clinical Behavior Both of these patients complained of a painless swelling in the jaw The older patient (Fig 306 A–J) whose symptoms were of longer duration had a tumor expanding the right mandible in the region of the angle, extending up into the ramus and along the body to the first molar tooth The third molar tooth was unerupted There was ulceration of the mucous membrane over the tumor In the younger patient (Fig 307 A–G) there was slight bulging of the buccal aspect of the left mandible in the cuspid bicuspid region With this exception the mandible presented a normal clinical picture of balanced development Although there was no history of elevation of temperature or pain there was annoyance and consciousness of fullness in the jaw

Roentgenographic findings. In case # 1 (Fig 306) there was a large multilocular radiolucent shadow involving most of the posterior third of the ramus and extending up into the ascending ramus. The unerupted molar tooth was pushed upward and backward but remained in the radiolucent shadow There was some trabeculation and a few areas suggesting honeycomb appearance These findings lead to the suspicion that this might be an ameloblastoma or a multilocular dentigerous cyst that had become infected and full of granulation tissue. Case # 2 (Fig 307) showed a multilocular radiolucent shadow within the central portion of the body of the left mandible from the second molar tooth around to and including the right lateral incisor tooth The apices of all teeth in the involved area were within the radiolucent area The outline of the cystic-appearing areas were for the most part regular although some of the cysts were so small as to suggest a bubble like appearance, not unlike that seen in the ameloblastoma Trabeculae were present in both cases

Histology Most of the tissue removed from Case # 1 was of a chronic inflammatory type, except that near the retained third molar tooth there was firm yellowish white, tissue translucent in appearance, and having a moist sticky surface. All the cavities in the jaw of Case # 2 were filled with firm, yellowish-white, translucent tissue with a moist surface similar to the tissue from Case # 1

Histologically these tumors presented a similar appearance. They were composed of stellate cells with long processes and other cells of a triangular or cuneiform shape. These cells were contained in a mucoid matrix made up of fine fibrils composing the delicate mesh work (See Fig 306 H)

Treatment. Conservative treatment was carried out first in both cases. The mucous membrane over the tumor was incised and all involved teeth removed In Case # 1 the unerupted third molar was extracted and the entire cavity curetted and packed with iodo-

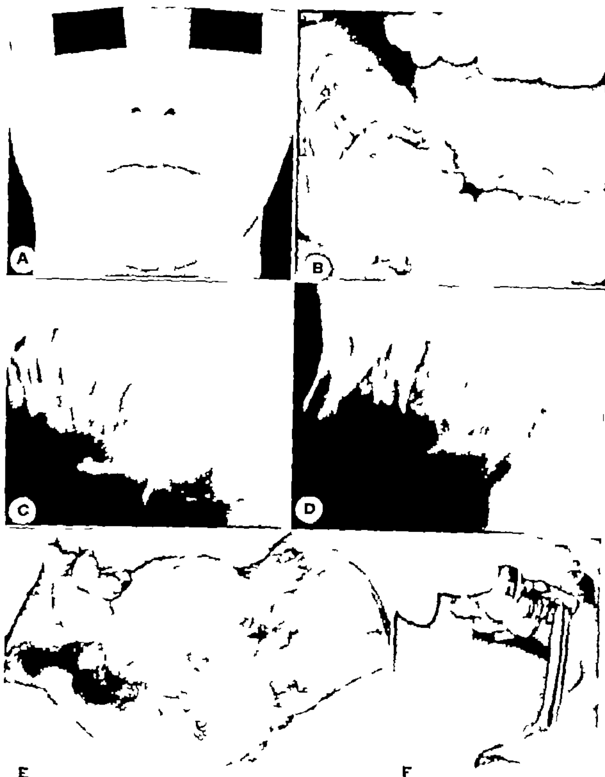


Fig 306 (A F) Fibromyxoma of the right mandible

A White female aged 19 Full faced view showing slight enlargement of the right cheek

B Photograph of lesion presenting in the mouth along the posterior lower alveolus There was slight ulceration. Tumor was red and soft.

C Roentgenogram showing radiolucent area containing third molar tooth Note trabeculation and also that the radiolucent area is not as dark as in a typical cyst signifying soft tissue in the cavity However because of the presence of the crown of the third molar an infected dentigerous cyst was considered Treatment consisted of thorough curettage and removal of the contained third molar tooth Most of the tissue was edematous and inflammatory but in the bottom of the cavity there was a hard glistening cartilaginous like mass which showed fibromyxoma.

D Roentgenogram 2 years later Notice the fine trabeculation which was at first considered to be new bone filling the defect Patient returned however with tumor again projecting into the mouth as shown in B

E Operative specimen lingual aspect Dissection was carried out extraorally Only a small amount of the condyloid process could be saved

F Prosthetic apparatus made by James E. Pyott and applied before second operation (extraoral resection)

form gauze. In Case #2 all teeth from the right lateral incisor to and including the unerupted third molar on the left side of the mandible were extracted. The mass of firm cavities, it was removed with the curette and rongeurs and the cavity packed after treating with a solution of tyrothricin and cauterizing with phenol.

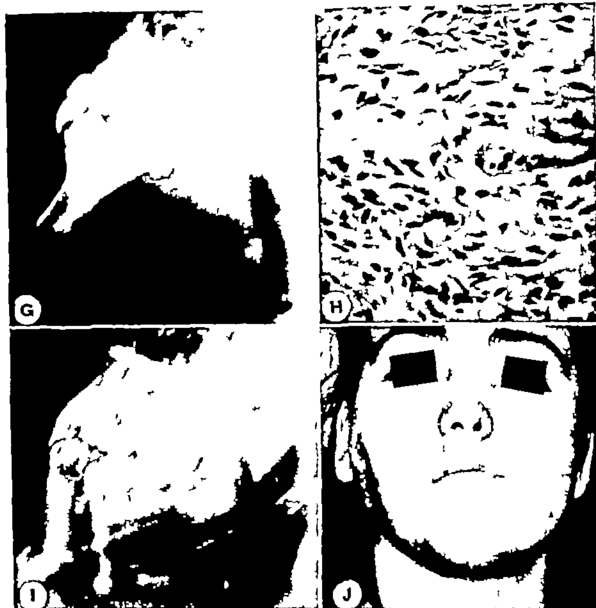


Fig. 306 (G–J)

G. Roentgenogram after jaw resection. Note small amount of condyle remaining for subsequent attachment of graft.

H. Photomicrograph, typical picture of fibromyxoma.

I. Roentgenogram showing rib graft put in six months after jaw resection. The upper end of the rib graft was split to fit over the small remaining stump of the condyle. The lower end was also split so that one tip was inserted into the marrow cavity of the distal stump of the mandible. Stainless steel wire fixed graft.

J. Photograph, full-face, following rib graft. Note slight flattening of face. Patient had such a good functional and cosmetic result that she married.

myxomatous tissue could not be removed in one piece because of the intervening bony trabeculae; however, by breaking down these trabeculae and following the growth into all

Both of these tumors recurred: #1 after about 2 years, and #2 after about six months. Radical jaw resections were done. Because the periosteum in Case #1 had been removed, it

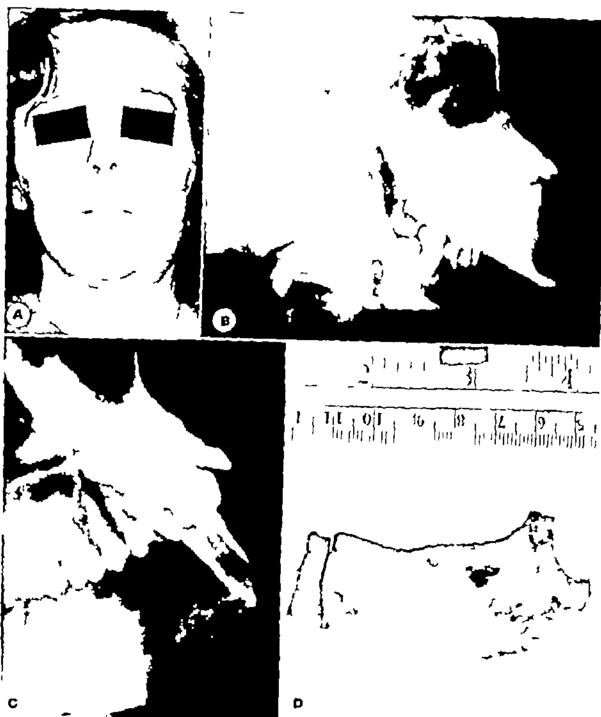


Fig 307 (A-D)

A. Fibromyxoma in white girl, aged 15. (Referred by B Lucien Brun.)

B Roentgenogram of left mandible showing radiolucent area extending from the root of the second molar around to the right cuspid tooth. All involved teeth and the left lower third molar were extracted and the tumor curetted. Whereas the roentgenogram suggests a multilocular cyst, a solid glistening tumor was found.

C. Roentgenogram. Recurrence six months after conservative operation. In view of the tendency of this type of tumor to recur, radical resection was advised. To prevent scarring, the operation was done intraorally.

D Surgical specimen viewed from the lingual side. After stripping back the soft parts of the chin, the jaw was severed with a Gigli saw through the socket of the right lower canine tooth. This permitted the angle of the jaw to be delivered out of the mouth and severed with a Gigli saw through the left third molar socket. It was found that a little tumor remained, so another centimeter of jaw was removed.



Fig 307 (E–G)

E. Photograph of patient two days after operation. She was fed through an intranasal tube for a week in order to keep the mouth clean A prosthesis, carrying teeth, prepared in advance by James E. Pyott was put in at operation to maintain mandibular fragments in normal occlusion.

F Prosthesis in place, jaw alignment held accurately by guide plane on the right

G Roentgenogram three months after operation. Prosthesis in place guide plane on the right and bar holding teeth on the left acrylic portion of the prosthesis not visible Since the resection had been carried out subperiosteally new bone is seen growing along the area from which the left mandible was resected This bone was quite firm except at the symphysis where there was fibrous union probably due to the fact that during the operation the periosteum at this point was injured Subsequently a rib graft about 3 cm. long was placed in the symphysis region through a small skin incision. Patient now has good function. She is now married.

was necessary subsequently to graft a rib reaching from the condyle to the stump of the body of the mandible. In Case #2 where the resection of the jaw was intraoral and sub-

CENTRAL FIBROSARCOMA

Under this heading are discussed fibrosarcoma of non-osteogenic origin which are true

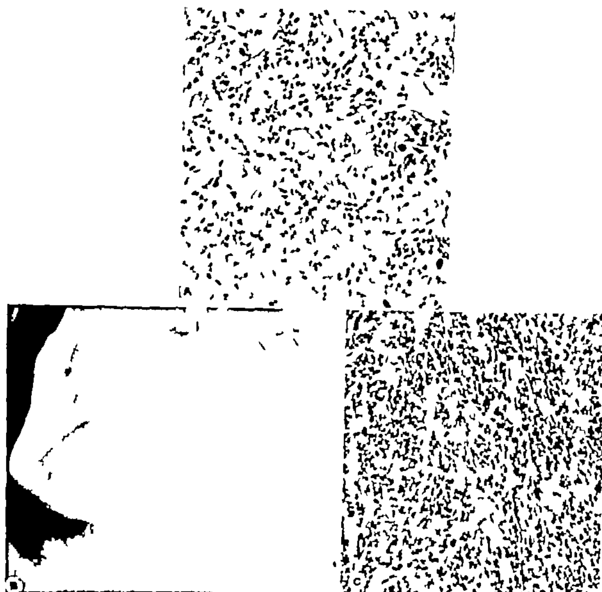


Fig 308 (A–C)

A. White female, aged 55 referred by Conrad Inman, in 1944 because of pain and expansion of the left mandible. Patient gave a history of fibrous epulis removed from left lower jaw in 1940 as in photomicrograph.
B Roentgenogram of left mandible (1944) There is an irregular area of radiolucency and slight increase in radio-opacity Diagnosis from roentgenogram undetermined.
C. Photomicrograph of tumor removed from the central portion of the mandible 1944 Very similar to fibroma removed in 1940. Eight months later patient returned with recurrent growth extending upward into the mouth medially toward the floor of the mouth and buccally into the cheek.

periosteal the patient re-grew the long narrow mandible in three months There was poor union at the symphysis which was subsequently united with a small piece of rib

fibrosarcoma of the fibrospindle cell type. These tumors are rare but should be borne in mind in the differential diagnosis of malignant tumors of the central portion of the jaw Cen-

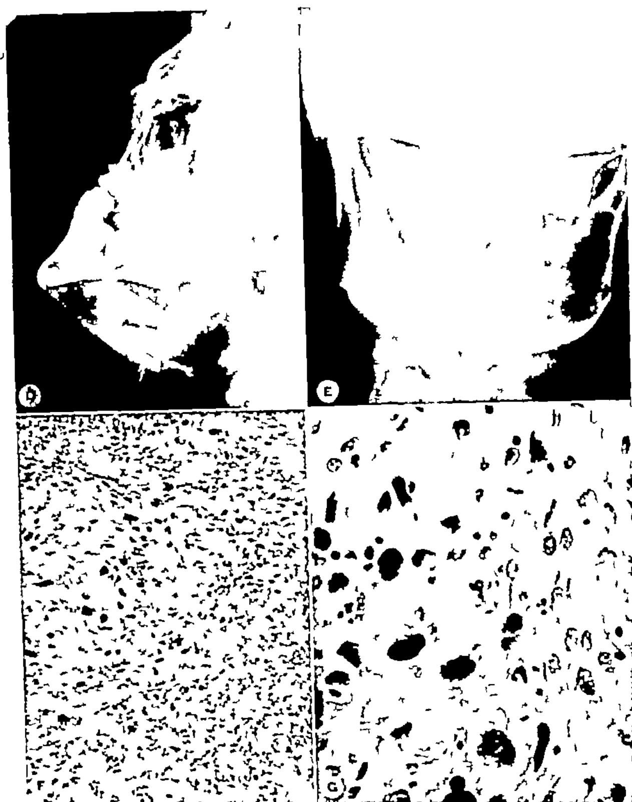


Fig. 308 (D-G)

D Lateral roentgenogram of jaw showing operative defect of seven months previous plus beginning extension of the growth anteriorly and downward through the mandible.

E. A P view showing destruction of the cortex with very little widening of the jaw

F and G Low and high power photomicrographs showing rapidly growing fibrosarcoma. Note variation in size and shape and staining qualities of the cells. Died of ruptured gastric ulcer and with extensive tumor

tral fibrosarcomas are to be distinguished from peripheral fibrosarcoma invading the bone from without

Pathogenesis. As mentioned under benign central fibroma, central fibrosarcoma arise from embryonic connective tissue cells within the bone. These are to be distinguished from odontogenic fibrosarcomas arising from the mesenchymal cells of tooth germs and those arising from the connective tissue of the nerve sheath which are described as neurogenic fibrosarcoma

Clinical Behavior The symptoms are those of pain and swelling in the affected part with corresponding disfigurement of the face. As with other malignant tumors of the jaws, there may be only loosening of the teeth and the character of the lesion discovered on roentgenographic examination

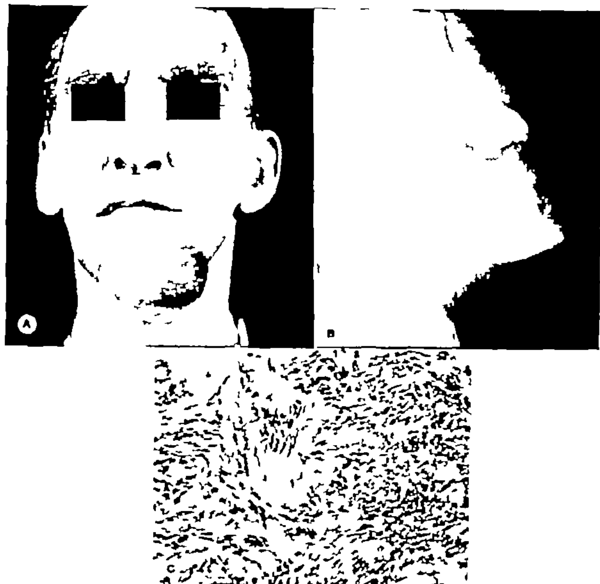


Fig 309 Fibrosarcoma of the mandible white male aged 53

A Clinical photograph showing extensive tumor stretching the skin of the chin. There is discoloration from invasion of the chin.

B Lateral roentgenogram showing irregular osteolytic destruction due to fibrosarcoma. The large soft tissue mass of slightly greater density than normal soft tissue is consistent with fibrosarcoma The bone destruction here is similar to that of osteogenic sarcoma, *but the age of the patient is more consistent with fibrosarcoma.*

C Photomicrograph, fibrospindle cell sarcoma

Roentgenographic Findings. The tumor is osteolytic in its action and therefore produces a radiolucent area which on account of the infiltrating character possesses an indistinct mar

gin Central fibrosarcomas may break through the cortex, but without evidence of periosteal activity as at times in osteogenic sarcoma (Fig 309 A–C)

Histology The tumor cells are spindle or oat-shaped and in some areas may acquire considerable cytoplasm There may be inter cellular collagenous material, staining pink. As the tumor takes on more rapid growth

Pathogenesis. As has been stated above, central fibroma and central fibrosarcoma may arise from the perineural sheath.

Histology The microscopic picture is typical of that of neurogenic fibroma, showing wavy nuclei in elongated cells appearing in bundles and whorls (Fig 310 A and B) In the schwannoma there is palisading of cells. Tumor giant cells may be seen.

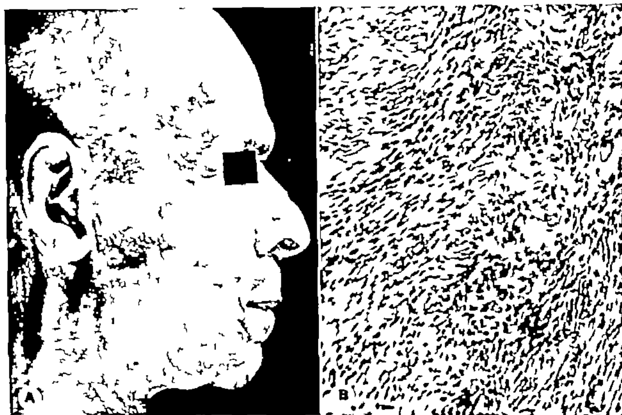


Fig 310 Neurogenic fibrospindle cell sarcoma, right mandible
A. Recurrent mass, right mandible after operation elsewhere.
B Photomicrograph spindle cells arranged in whorls and interlacing bundles suggestive of neurogenic origin.

metaplasia is common and there is marked irregularity in the size and shape of the cells (see Fig 308 F and G) In two of our three cases, there were areas of myxomatous change, causing the diagnosis of fibromyxosarcoma to be made

Treatment. Radical resection of the jaw, with a wide margin of surrounding soft parts, is the method of choice.

NEUROGENIC FIBROSARCOMA

These tumors like the fibrosarcoma described above, are very rare and may simulate histologically the various types of neurogenic fibrosarcoma

Clinical and roentgenological features are similar to those already described for fibrosarcoma.

Treatment must be radical resection of the jaw and adjacent soft parts

Fibrosarcomas, of whatever origin are rare. There were six cases in our study one fibrosarcoma two fibromyxosarcomas and three spindle-cell sarcomas (probably of neurogenic origin)

The one fibrosarcoma in a white female, aged fifty three, is illustrated in Figure 308 The legend tells the story

The two cases of fibromyxosarcoma were in boys twelve and thirteen years of age Both

gave symptoms of disability one with pain and swelling and one with swelling only The tumors were infiltrative and treated with radical surgery followed by x ray therapy One died in two years one was living and well after three years and lost to follow up

The three cases of spindle-cell sarcoma were in males, one each in the fourth fifth and eighth decade. Two complained of pain swelling and disability one of pain only The duration of symptoms in all three was four years and all occurred on the lower jaw

These three patients were all treated with radical surgical resection. One case was followed two years and died of metastases one was lost to follow up

The third patient, shown in Figure 310 is still well three years after operation and returns for check up examination to the tumor clinic periodically

CENTRAL ANGIOMA

Central angiomas of the jaws are rare and are to be distinguished from angiomas of the vessels of the periosteum or mucous membrane of the mouth which invade the outer surfaces of the jaw The central angiomas form in the marrow or spongiosa.

Clinical Behavior Angiomas may occur at any age and may present no clinical characteristics They are slow in development and of a benign character A few have been reported of rapid development. Pain is a frequent symptom and may be pulsating in character Large tumors expand the bone causing facial disfigurement The great danger of angiomas lies in the difficulty of recognition. Surgical interference by incision or extraction of a tooth may cause sudden and severe hemorrhage. Thoma states that the danger of death from hemorrhage is greater than from malignancy '

Roentgenographic Findings. There are small multilocular radiolucent areas resembling the so-called *soap bubble effect* The bone is expanded in a manner similar to that of giant cell tumor There is a fine fibrillar network within the cystic cavities.

Histology is that of cavernous and capillary hemangioma. The spaces are lined with endothelium and contain blood.

Treatment is ligation of the major artery or arteries supplying the tumor Pre- and postoperative roentgen therapy has been used to sclerose the vessels

ENDOTHELIAL MYELOMA

(Ewing's Tumor) and granulomatous diseases of the jaws are discussed with tumors of the skull Chapter XX and will not be included here

Odontogenic Mesenchymal Tumors

SOFT ODONTOMA

The soft odontoma may be of mesenchymal origin alone without evidence of dental epithelium. Their signs and symptoms and roentgenological diagnosis and treatment have been dealt with under a previous section and further discussion will not be given

Benign Giant Cell Tumors

The discussion of benign giant cell tumors of the jaws here does not include those that are associated with hyperparathyroidism Reference is made to hyperparathyroidism in Chapter XVII Two types of giant cell tumors are concerned in this chapter one, the peripheral giant cell tumor or epulis and the other central giant cell tumor

GIANT CELL EPULIS OR PERIPHERAL GIANT CELL TUMOR

These tumors appear most frequently in children and young adults between ten and twenty years of age or during the period of eruption of the permanent teeth and occur usually near the canine, bicuspid, or incisor teeth, and also about the roots of those permanent teeth which are preceded by a deciduous dentition (Geschickter 1935) These growths are to be distinguished from so-called *fibrous epulis* and peripheral fibroma Peripheral fibromas are true fibrous tumors Many so-called *fibrous epulis* are fibrosed granulomas (see Chapt VII)

Giant cell epuli arise from the pericementum or alveolar dental periosteum They are related to the normal proliferation of odontoclasts occurring in the cementum about the roots of the deciduous teeth The odontoclasts absorb the cementum and loosen the deciduous teeth in preparation for the permanent teeth The deciduous teeth are loosened during the first



Fig 311 (A–B)

A and B Roentgenograms of left mandible (1933) Boy 10 years old. Note destruction of bone and irregularity of teeth Large peripheral tumor, 3 cm in diameter springing from jaw and extending into cheek Electrosurgical removal under nerve block and local infiltration anesthesia of the buccal mucous membrane. Radium applied against the tumor (dose—250 mg hr filtration 1 mm Pt and 1 mm rubber)

decade, but the majority of giant cell epuli occur later This latent period is accounted for by the slow growth of these benign tumors and by the occasional activation of odontoclasts during pregnancy The odontoclastic activity about the teeth is analogous to the odontoclastic hyperplasia which attacks calcified cartilage in the intracartilaginous bone of the skull and in the long bone. The deciduous teeth similar to calcified cartilage, are temporary structures and the pathological process of giant cell tumor may arise in connection with either " (Geschickter 1935)



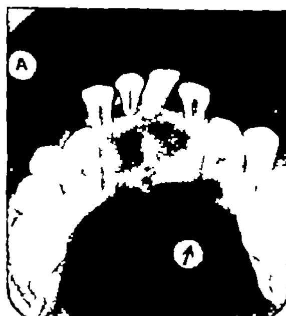
Fig 311 (C–D)

C Photomicrograph. Note that giant cells are springing from the endothelial lining of the blood vessels. This is one theory of the origin of certain types of giant cell tumors. This patient has grown to manhood and is married and came to see us in May 1949 perfectly well.

D Roentgenogram one year later Remaining teeth in good occlusion.

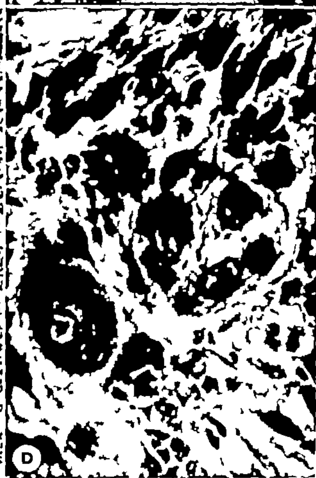
Histology Under the microscope these tumors are found to be made up of many multinucleated giant cells in a dense fibrous stroma. There is no inflammatory reaction The tumors are usually covered with mucous membrane.

In one of our cases (Fig 311) giant cells


A


B


C


D


E


F

appeared in the large blood spaces of the tumor This suggested to the late Curtis F Burnam (personal communication) who reviewed the slides, that the giant cells in this case may have come from the endothelial lining of blood vessels.

Clinical Behavior There is localized swelling without other symptoms. The tumor is sessile or pedunculated, soft, and of deep red or mottled color They bleed on slight trauma True giant cell epuli rarely grow beyond 2 or 2.5 cm. in diameter Fibrosed granulomas may attain larger size.

Roentgenographic Findings. There is no invasion of the bone seen in x ray films (Fig 312 A F) but the bone and teeth may be destroyed by pressure with corresponding regular outlines of the defect due to resorption of the bone.

Treatment is wide surgical excision with chemical or thermocauterization. In our hands electrosurgical removal with electrodesiccation or mild electrocoagulation of the base suffices to cure It is not always necessary to extract the involved teeth unless pressure has destroyed the bone sufficiently to prohibit the maintenance of a good socket Curtis F Burnam (personal communication) held that these tumors were quite radiosensitive In this opinion Sorland and Costolow agree Kazanjian holds that giant cell epuli are highly resistant to radiation therapy We feel that electrosurgical removal is preferable to radiation as there is less damage to the underlying bone and less likelihood of late destruction of the teeth from obliterating endarteritis.

MALIGNANT TUMORS METASTATIC TO THE JAWS

Secondary involvement of the jaws from malignancy elsewhere in the body is not common The diagnosis of such a metastasis must be made by the exclusion of primary jaw tumors and confirmed by a careful search for a primary focus and then substantiated by histological examination Carcinoma metastatic from lip, breast, lung (Fig 313 A–C) prostate gland, stomach thyroid gland hypernephroma, adrenal gland, etc. has been reported. Sarcoma metastatic from melanosarcoma, lymphosarcoma, soft tissue sarcoma, etc., has also been described in the literature. Very rarely the metastasis to the jaw has been the chief complaint which brought the patient to the physician

Pathogenesis. The transportation of tumor cells to the jaw may be through the lymphatics (lip—see chapter on cancer of the lip) and floor of the mouth, tongue and cheek Metastasis from more distant organs is probably through the blood stream

Clinical Behavior The symptoms are those of any other malignant tumor of the jaws. They may give pain of a rheumatoid character and other neurological manifestations due to pressure on the nerve within the jaws Systemic symptoms, due to the primary disease focus sooner or later develop

Roentgenographic findings are those of other malignant neoplasms of the jaws. The radiolucent areas will be irregular in shape, due to irregular invasion of the bone The amount of destruction depends upon the extent of the disease process

Treatment is palliative and symptomatic.

Neuroblastoma of the Adrenal Metastasizing to the Mandible and Orbit

Malignant tumors arising from undifferentiated nerve tissue in the adrenal medulla in rare instances metastasize to bone. Figure 314 A and B illustrates one such tumor metastasiz

Fig 312 White boy aged 9 peripheral giant cell tumor of the lower jaw (epulis)

A and B Roentgenograms showing displacement of deciduai and permanent teeth by tumor In "A" notice line indicating edge of tumor which looks like the wall of a cyst (arrow) Tumor presented in the floor of the mouth was ulcerated and bled No pain. There was difficulty in talking Note bone destruction is by pressure and not invasion Note poor occlusal line in "B"

C and D Low and high power photomicrographs showing giant cell tumor

E and F Roentgenograms taken one year after electrosurgical removal of tumor Note in "E" remaining permanent teeth that have grown up into place. The growth of the jaw and spacing of the teeth were controlled by proper prosthesis In "F" note normal occlusion line of teeth.

ing to the orbit and mandible. The so-called *Hutchinson type* has a predilection to bone whereas, in the Pepper type the spread takes place chiefly to the liver which may be enormously enlarged. The Pepper type is less well-differentiated and runs a more rapid course.

The disease usually occurs in small children and infants. The first symptom often is echymosis about the eye which the mother attributes to a fall. Gradually proptosis develops, associated with swelling of the side of the head. The metastatic tumor of the head may reach a large size before an abdominal growth is demonstrable. Secondary metastases may

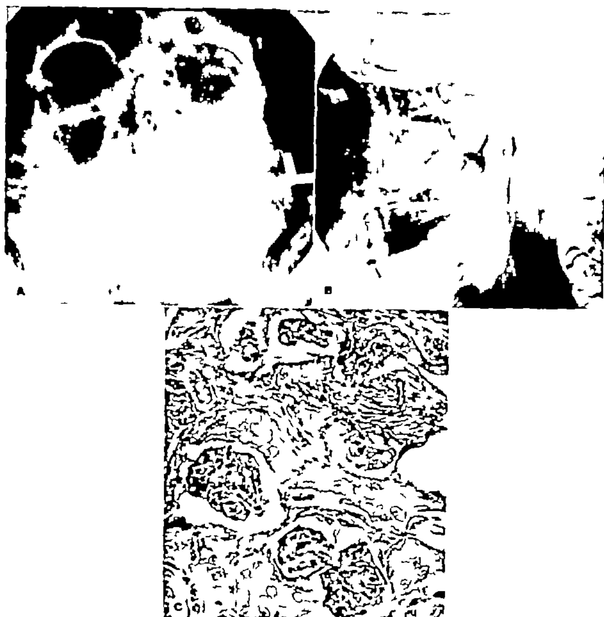


Fig. 313 Carcinoma of the lung metastatic to the left maxilla. Patient was a white male aged 33. First symptoms were pain in his back and right leg. Patient had metastases to the spine and lower end of the right femur before primary lesion was discernible in the lung. Attention to the left maxilla was called by swelling and pain.

A. Roentgenogram A P view showing obliteration of the antrum by a tumor in which new bone was being laid down.

B Lateral view indicating bone reaction around tumor

C. Photomicrograph showing islands of squamous epithelium in the bone. At operation the antral wall was found to be very much thickened by new bone production. This illustration is put in as an example of metastases of malignant tumors from distant organs. Patient seen in consultation with Dr Milton B Kirsh (Roentgenogram, courtesy Sinai Hospital Baltimore.)

also be in the ribs, spine, and long bones Ewing (1928) states that hypernephroma may also produce the same syndrome. Frew quoted by Ewing describes the secondary growth in different locations of the body as follows

Tumors of the left adrenal invade the regional lymph nodes and pass downward along the iliacs to the pelvis and groin thence across to the mesenteric nodes and up to the liver From the liver they enter the portal spaces, thence pass to the posterior mediastinum and along the intercostal lymphatics. From here they pass up the deep cervical chain to the skull (Hutchinson s type) Tumors in the right adrenal invade the local lymphatics and extend to the liver pleura and lungs (Pepper type) These tumors are not sensitive to radiation and the outlook is always very bad The following is a brief history of our case

The patient entered the University Hospital with a history of injury to the right side of the jaw six weeks before A lump appeared which was not painful nor discolored and increased in size gradually involving the right eye.

On admission the examination was essentially negative except for the mass in the right side of the face and the proptosis. Serological test for syphilis was negative tuberculin test was negative. Blood examination showed mild secondary anemia and no increase in the white blood cell count.

Roentgenographic Findings

Skull Examination of the skull showed large tumor mass in the region of the right mandible. There appears to be partial destruction of the horizontal and descending rami of the mandible, as well as destruction of the malar bone on this side. The cranial bones are otherwise normal in texture. Impression Sarcoma with bone invasion (right mandible)

X rays of the chest and abdomen were negative X rays of the kidney ureters, and bladder were negative except for increased density in the upper left abdomen which is suggestive of a moderate enlargement of the spleen. Long bones show multiple areas of destruction due to metastatic malignancy

Patient received 1550 r to the mass on the jaw without the slightest improvement.



Fig 314

A. A very ill child with neurocytoma of the adrenal gland (Hutchinson s type) with metastases to mandible and orbit

B Photomicrograph showing rosette arrangement of neurocytoma cells

Geschickler and Copeland emphasize that bone involvement in children suffering from this disease must be differentiated from Christian Schuller s syndrome chloroma leukemia, Ewing's sarcoma and Wilms s tumor of the kidney Response to irradiation and differential blood cell counts help to distinguish leukemia.

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Chapter XI

SALIVARY TISSUE TUMORS

Salivary tissue like other tissues of the body is subject to *developmental anomalies, neoplastic* proliferation, acute and chronic inflammatory disease and injury of both the stroma and parenchymatous elements. This work in the main being devoted to the diagnosis and treatment of neoplastic disease includes a discussion of inflammations largely from a differential diagnostic standpoint.

Mixed tumors are the most common and interesting salivary tissue affections. Their growth is slow and inconspicuous at first but persistent. They produce few symptoms, except a visible or palpable tumor for long periods of time. The tendency for mixed tumors to become malignant and give symptoms, other than cosmetic, makes their prophylactic re*moval mandatory. They are amenable to ade*quate surgical excision.

Aberrant salivary tissue is frequently en*countered in the lips, cheeks, jaws,* lacrimal apparatus, eyelids, eyebrows, and skin of the face and neck (Ewing). Like aberrant tissue found in other areas of the body when permitted to persist and proliferate, it may undergo malignant transformation.

Cysts and adenomas are rare and in the beginning are similar to mixed tumors because of benignancy. Their relation to malignancy is not well understood; we have observed carcinoma in salivary cysts which emphasizes the necessity of adequate surgical removal.

Primary malignancies of the salivary glands are not infrequent, occurring as a rule in older patients, but we have seen three in infants. Due to the peculiar anatomical structure of the parotid gland, it is more frequently involved than the other salivary glands by either primary or secondary malignancy (developing from mixed tumors) (Table 23).

Superficial and deep lymphoid tissue is pres*ent in the salivary glands, consequently they* may be the seat of primary lymphoma or metastases from epithelial malignancies in their lymph drainage areas. Such *conditions* frequently present interesting problems from a differential diagnostic standpoint.

TABLE 23

Salivary Tissue Tumors—142 Cases
(Ward-Hendrick Lacy, Johns Hopkins *Hospital—1932–1948)*

	No. Cases	Percentage of Total
Parotid Gland Tumors	100	70.9
Submaxillary Gland Tumors	24	17
Tumors Involving Aberrant Salivary Tissue	18	12.1
	142	100

CLASSIFICATION

A workable classification of salivary lesions is as follows:

1. Inflammations
2. Mixed tumor of salivery tissue origin
   a. benign
   b. malignant
3. Muco-epidermoid tumors
   a. benign
   b. malignant
4. Anaplastic carcinoma
5. Adenoid cystic carcinoma (identical with those found in the skin)
6. Warthin tumor (papillary cystadenoma lymphomatosum)
7. Secondary involvement of the salivary glands from malignancy in their drainage areas
8. Primary lymphomas

ANATOMICAL CONSIDERATIONS OF THE SALIVARY GLANDS

The *parotid gland* is the largest of the salivary glands. It lies below and in front of the ear as its name designates— situated near the ear.' It is irregular in outline and has the general shape of a collar button. The anterior surface is covered by skin and superficial fascia.

The gland overlaps the masseter muscle and the ramus of the mandible. Its superior surface extends to the zygomatic arch. The posterior border is in relation to the external auditory meatus, the mastoid process, the sternomastoid muscle, the styloid process, and the digastric muscle. The lower pole of the gland winds itself around the ramus of the mandible to its medial surface, where it enters the retromandibular space and forms the pterygoid or retromandibular lobe. As it winds around the ramus of the mandible posteriorly, it is practically divided into two lobes connected by a narrow isthmus (Fig. 331) as shown by McWhorter. This is quite important from a surgical standpoint because between the two lobes the facial nerve divides around the isthmus. The inferior border of the gland extends well downward along the anterior aspect of the sternomastoid muscle. The medial or retromandibular process is in relation to the internal pterygoid muscle and not infrequently extends to the lateral wall of the pharynx (Fig. 315).

THE FIBROUS CAPSULE OF THE PAROTID

The parotid gland is closely invested with a dense fascial capsule derived from the enveloping layer of the fascia of the neck. It is continuous with the fibrous sheath of the masseter and sternomastoid muscles and is attached above to the zygomatic arch. The parotid fascia is thickened below into a dense fascial band extending from the angle of the mandible to the lower part of the styloid process, called the *stylomandibular ligament*. The inner surface of the fascial sheath is closely applied to and sends small fibrosepta into the gland dividing it into lobules. The capsule is very thin and practically nonexistent over and incompletely covers the medial aspect of the retromandibular lobe. The area between the retromandibular lobe and pharynx is filled with loose connective tissue. An infection or tumor developing in or near the pharyngeal wall may involve the retromandibular lobe and push it outward.

Due to the thick fibrous capsule over the superficial lobe, the space occupied by the parotid gland is limited. Infection or tumor puts

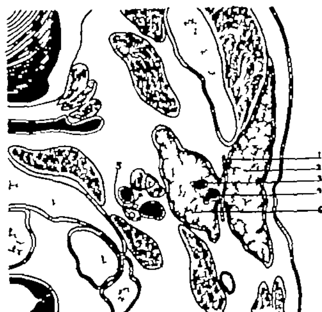


Fig. 315. Schematic sketch to illustrate the anatomical relationships of the parotid gland, facial nerve, carotid arteries, jugular vein, last four cranial nerves and the pharynx.
1. Facial nerve
2. Superficial lobe of parotid gland
3. External carotid artery
4. External jugular vein
5. Last four cranial nerves, internal carotid artery and internal jugular vein
6. Retromandibular lobe of parotid gland
(Redrawn from Callander's Surgical Anatomy.)

the capsule on stretch, pushes the ramus of the mandible forward, and produces fullness in the upper part of the neck. A patient with a deep infection or tumor holds his head extended backward, the mandible forward, relieving to some degree the pressure over the lower pole of the parotid. This is an important clinical sign for when the patient is asked to flex his head and rotate it toward the affected side, the mandible presses against the already tense gland producing pain over the lower pole.

The auriculotemporal and auricular major

nerves are the sensory nerves of the parotid gland They are contained in the fascial capsule, permitting them to be involved directly by rapid growing tumors or acute infections. The auriculotemporal nerve is a sensory branch of the mandibular nerve, therefore, pain may radiate up in front of the ear to the vertex of fication over the substance of the retromandibular lobe This point was first emphasized by McWhorter (1917) who showed that tumors arising from a superficial area of the gland or its lower pole might grow to an enormous size without involving the branches of the facial nerve from pressure but small tumors

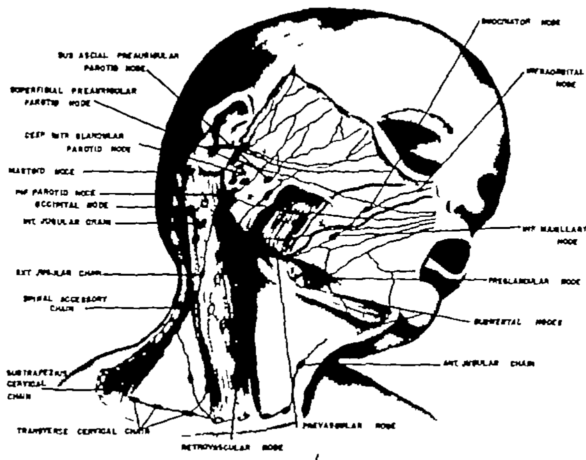


Fig 316. Schematic representation of the lymphatic drainage to the lymph nodes within the parotid gland and to the region of the submaxillary gland Also the jugular chain of nodes that receive drainage from the parotid and submaxillary nodes. (Redrawn from Rouviere The Human Lymphatic System 1938 Edwards Bros Ann Arbor Mich)

the skull Malignant lesions cause exquisite pain at times.

THE FACIAL NERVE

After it leaves the stylomastoid foramen the facial nerve passes laterally slightly downward and medial to the posterior surface of the major lobe of the parotid gland anteriorly over the substance of the retromandibular lobe It crosses over the external carotid artery and jugular vein to divide into its goose foot rami arising from the retromandibular lobe frequently involve the facial nerve especially the lower branches

THE LYMPHATIC VESSELS AND NODES OF THE PAROTID

The lymphatic vessels and nodes of the parotid region are divided into two groups (Fig 316) A small group of nodes lies superficial to the parotid sheath and receives afferent vessels from the temple and frontal regions of the

scalp eyelids, and outer ear Numerous nodes are scattered throughout the substance of the gland and drain the lymph from the middle ear the soft palate, the upper and posterior part of the nasopharynx and some of the channels from the upper lip The afferent vessels from the superficial and deep nodes drain into the superficial and deep jugular chain

It will be noted in Figure 315 that the medial surface of the retromandibular lobe lies in close apposition to the lateral wall of the pharynx the internal carotid artery and internal jugular vein, and the last four cranial nerves Tumors arising from the medial part of that lobe often produce symptoms of pressure on those structures. Also, they can produce pressure on the pharynx

ANATOMY OF THE SUBMAXILLARY AND SUBLINGUAL GLANDS

The submaxillary gland is about ½ to ⅓ the size of the parotid and occupies a space between the inferior border of the mandible and the hyoid bone It is in relation with the mylohyoid muscle the posterior belly of the digastric and the stylohyoid muscles. It may extend posteriorly to the sternomastoid muscles. Frequently a prolongation of the gland extends upward along Wharton s duct between the mylohyoid and the hyoglossus muscles to the posterior area of the sublingual gland The sublingual gland is about one half the size of the submaxillary, being about 2 x 3 cm., and is found along the floor of the mouth, just beneath the mucosa The submaxillary gland has a rather indefinite fascial capsule. There are usually five or six lymph nodes within the capsule and the substance of the submaxillary gland, and also between the gland and the mylohyoid muscle and under the mylohyoid muscle These nodes receive afferent vessels from the anterior and lateral areas of the tongue, nose, lips, and floor of the mouth They are frequently involved by malignancies in their drainage area Their afferent vessels extend to the deep cervical chain The external maxillary artery after arising from the external carotid artery enters the compartment of the submaxillary gland under its posterior border It continues upward in a groove on the posterior surface of the gland and winds around the anterior surface of the mandible. Numerous superficial veins are found on the anterior surface of the gland

The hypoglossal nerve enters the submaxillary space between the posterior belly of the digastric and the hyoglossal muscles and runs through the greater portion of the suprahyoid space before entering the sublingual compartment through a cleft between the hyoglossal and the mylohyoid muscle. The lingual nerve lies at a higher level on the lateral surface of the hyoglossal muscle. These nerves may be injured in excision of the submaxillary gland

LESIONS OF SALIVARY TISSUE

Inflammations

Inflammatory lesions of the salivary glands frequently follow an acute pharyngeal, oral, or dental infection As a rule, there is a history of rapid onset, either in the parotid or submaxillary glands. Stones in the duct of the parotid or submaxillary gland often unrecognized obstruct the ducts causing the affected gland to become enlarged tender and painful (Fig 317 A and B) When the obstruction is allowed to persist, the gland becomes diffusely enlarged, permanent changes ensue, the gland parenchyma is destroyed to a marked degree and is replaced by lymphocytic infiltration and fibrosis. This type of obstruction was noted in a forty five year-old male who gave a history of an enlarged left submaxillary gland of three years duration Examination revealed a firm tumor of the left submaxillary gland measuring 5 x 7 cm. The gland was diffusely enlarged with an associated ranula from obstruction of Wharton s duct When the submaxillary gland was excised, the histological picture showed lymphocytic infiltration and marked fibrosis with very little epithelial tissue remaining

Mikulicz's disease involves the parotid gland more frequently than the submaxillary, however both may be affected. The lacrimal apparatus is later implicated. It is an infectious



Fig 317

A Roentgenogram showing large calculi in Wharton's duct

B Cross section of submaxillary gland that measures 4 x 6 cm showing calculi obstructing Wharton's duct Histological examination showed lymphocytic infiltration and marked fibrosis with little epithelial tissue remaining

granuloma and thought by some observers to be associated with leukemia or Hodgkin's disease. One patient within the past two years entered the clinic with a history of a slowly developing tumor of the left parotid gland of two years duration About six months afterwards, the right parotid gland became involved Later the lacrimal gland as well as the submaxillary gland became painful and tender The patient ran a low grade fever Examination showed a rather diffuse enlargement of both parotid glands which were tender and painful with only slight enlargement of the submaxillary glands. Biopsy of the parotid gland confirmed the diagnosis of Mikulicz's disease.

Patients occasionally give a history of gradual enlargement of one or both parotid glands, extending over a period of one to three years. At first the gland is rather tender and painful later these symptoms disappear There is diffuse firm enlargement of the gland which becomes immobile and slightly tender on firm pressure (Fig 318 A and B) The lower branches of the facial nerve may be involved with a partial paralysis of the muscle supplied Histological examination of tissue removed reveals a marked lymphocytic infiltration and extensive fibrosis. Only scattered remnants of epithelial elements remain This latter observation paralysis of fibers of the 7th nerve, gave credence to the early thought of sarcomatous changes (Swinton and Warren)

Sarcoidosis, or Boeck-Schaumann disease, may affect the salivary glands, as well as other organs of the body The histogenesis of this disease is obscure and was likened to Hodgkin's disease by Schaumann as it may affect any organ of the body but is prone to appear in the lymphoid tissue The cases at the Johns Hopkins Hospital have been carefully studied by Longcope and his associates. The following case illustrates its appearance in the parotid gland

A white male patient, aged twenty-eight was observed in the medical clinics for a period of months with an irregular fever and no definite diagnostic symptoms except that each parotid gland began to develop a diffuse enlargement which was tender and slightly painful on pressure The right gland was larger than the left when seen in the tumor clinic The blood count was 6 000, with an eosinophilia of 30 per cent Biopsy of each parotid gland revealed sarcoidosis (Fig 319 A and B) Blood chemical analysis showed an increase in the plasma protein with an inversion of the albumin globulin ratio



Fig. 318

A. History of gradual enlargement of left parotid gland over a period of three years. Gland is slightly tender and flabby no evidence of a neoplasm.

B Histological examination reveals marked lymphocytic infiltration and extensive fibrosis with little parenchymatous tissue remaining.

Benign Mixed Tumor

This most interesting type of tumor may affect all salivary tissue, parotid submaxillary, sublingual and aberrant wherever located The parotid gland is more frequently involved

by benign or malignant tumors than the other salivary glands Stein and Geschickter in a study of the affections of the parotid gland in the Johns Hopkins Hospital from the date of its formation to 1931 noted that it was involved by tumors in 241 cases One hundred ninety nine or 83 per cent were mixed tumors In our continuation of this study from 1931 until the present there were 142 tumors involving all salivary tissue 112 of which were mixed tumors. It is therefore apparent that about 86.5 per cent of tumors involving salivary tissue are of the mixed variety either benign or malignant

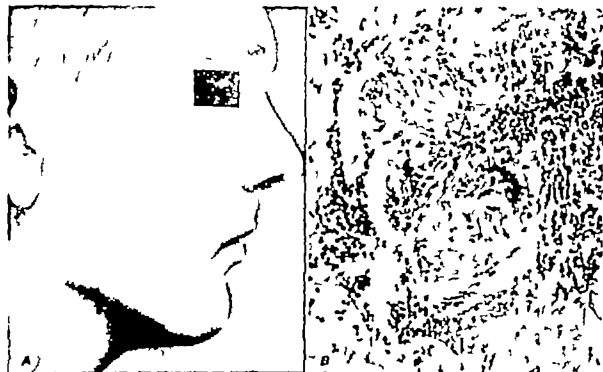


Fig. 319 Sarcoidosis involving both parotid glands

A Irregular temperature of ten months duration WBC 6,000 eosinophiles, 30% blood chemical analysis showed an increase in the plasma protein with inversion of the albumin globulin ratio

B Biopsy of each parotid gland reveals sarcoidosis. Circumscribed masses of epitheloid cells occasional giant cell delicate fibrous reticulum

CLINICAL BEHAVIOR

Mixed tumors are about equally encountered in males and females The colored race is involved as well as the white Both sides of the face are about equally affected No age is exempt from mixed tumors The youngest patient in this group was eight years of age and the oldest eighty-one. One patient was the proud possessor of his tumor for forty-one years and had it removed then only because he was elected an officer in his church A case was reported by McFarland in a baby eight months of age. The benign mixed tumors of either the parotid or submaxillary glands are usually non tender unless the center has become cystic, the seat of recent hemorrhage rapidly increasing the size of the tumor This was noted in a forty-one-year-old colored female who had a large mixed tumor of the parotid for a period of seventeen years It was almost the size of a grapefruit The patient stated that the tumor was not painful until she accidentally bumped her face against the side of a door Immediately the tumor increased remarkably in size and when she was seen in the clinic two weeks later there was some impairment in the lower branches of the facial nerve The tumor was very tense Malignant transformation was suspected When the tumor was removed at opera

tion and sectioned there was evidence of recent hemorrhage and no malignancy

The rate of growth varies markedly in different tumors. It seems that tumors deep in the substance of the gland develop more rapidly than superficial tumors. Tumors containing a large amount of epithelial tissue have a history of more rapid growth than the ones in which fibrous or myxomatous tissue predominate. Mixed tumors grow slowly up to 1 or 2 cm to the size of a grapefruit, then remain stationary for variable periods of time. After an upper respiratory infection or mild trauma, they commence their growth again It was reported by McFarland that the smaller tumors are more apt to recur or to invade their capsule and show evidence of malignancy than the large ones It is probable that the same amount of care was not exercised in completely removing the small tumors as in removing the larger ones thereby leaving some of the neoplastic tissue or the capsule to form the nidus for further growth Table 27 presents the main differential points between benign and malignant salivary tissue tumors

Although mixed tumors affect all three of the salivary glands, Hertzler pointed out a difference in the structure as well as the clinical course He also stressed the fact that mixed tumors of the parotid presented a greater complexity of structure and were much more likely to become malignant than mixed tumors of other glands With this in mind the involvement of the glands will be considered separately

Typical mixed tumor of the parotid gland. This develops as an ovoid or bosselated mass below and in front of the ear (Fig 320) They are seldom encountered in the upper area of the gland in contradistinction to cysts adenomas and primary malignancies. At first, mixed tumors are freely movable over the underlying tissue especially if they are located superficially They may form large tumors which tend to become pendant and grow away from rather than within the gland Other tumors developing within the substance of the gland produce a diffuse enlargement These latter are rather immobile and form a more or less rounded mass. Such tumors have a greater likelihood of involvement of the lower fibers of the facial nerve than the superficial ones.

The average length of time that elapsed from the onset of the recognition of a lump in the parotid gland until the patient consulted the clinic was eight years. The average age of the majority of cases was between twenty and forty five years of age when they first observed the tumor

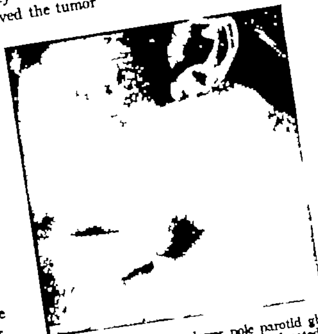


Fig 320 Mixed tumor lower pole parotid gland, three years duration. Tumor is superfically located and freely movable.

As the tumor enlarges, the skin over it may be thinned out as the result of pressure with destruction of the hair follicles and eventually necrosis (Figs. 321 and 322), along with involvement of some of the branches of the facial nerve, a symptom suggestive of malignant transformation but, however, may be due to pressure Also in tumors developing in the retromandibular lobe there may be pressure necrosis of the ramus of the mandible, so well demonstrated in the following case.

A white male, sixty-one years of age, gave a history of the presence of a tumor for eighteen years. There were no symptoms other than a sensation of pressure over the tumor when the head was flexed About eighteen months before his first visit he noticed pain in the angle of the

jaw and later a disturbance in mastication X ray examination of the mandible revealed pressure necrosis and absorption When the tumor was removed it was found to be deeply



Fig. 321 Mixed tumor parotid gland present 26 years. Rapid increase in size during the past six months. The skin is markedly thinned out over the summit of the tumor Lower branches of facial nerve impaired

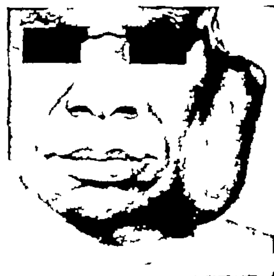


Fig. 322. Bosselated mixed tumor involving superficial and retromandibular lobes, parotid gland producing pressure in the region of the pharynx.

situated in the retromandibular lobe There was *no* evidence of malignancy and no recurrence

Enlarging tumors developing deep in the parotid gland not infrequently bulge in the mouth where they may produce symptoms of pressure and difficulty in swallowing

Mixed tumors of the submaxillary and sublingual glands. About 15 per cent of mixed tumors involve these glands Patients with mixed tumors of the submaxillary and sublingual glands presented themselves for treatment within two or three years after they noticed the tumor Beginning as a small tumor beneath the jaw just in front of the angle (Fig 323) it increases in size to occupy a large area of the neck and even form pendant tumors.



Fig 323. Mixed tumor left submaxillary gland that produces a nodular swelling beneath the angle of the mandible.

Tumors having origin in the posterior area of the submaxillary gland frequently present difficulty *in differentiation from tumors* in the lower pole of the parotid gland In such cases, the tumor frequently grows backward along the floor of the mouth to girdle the posterior border of the mylohyoid muscle Bimanual examination with one finger in the mouth and the other on the tumor differentiates its submaxillary origin from parotid origin

Tumors arising in the sublingual gland present in the floor of the mouth and are prevented from extending downward by the mylohyoid

muscle They tend to be further forward than those developing in the submaxillary gland.

NATURE OF MIXED TUMORS

The derivation of both epithelial and connective tissue elements encountered in mixed tumors of salivary glands has been the basis of a lively discussion since such tumors were first described by Kaltschmied in 1752 The pendulum has been in constant motion swinging back and forth from Virchow s assumption (1863) that the tumors are of epithelial origin to others who held that the tumors developed from connective tissue However Virchow later pointed out that the cartilage in the tumor was probably due to metaplasia of connective tissue Cohnheim also advocated the epithelial origin of these tumors.

Kaufmann and later Volkmann advanced the theory that they sprang from endothelium, but that the more cellular elements were probably of epithelial origin Clementz and later Krompecher along with others, propounded the theory that the cartilaginous material was produced by metaplasia or mucoid regression of the epithelial cells of the tumor

Kaufmann later attempted to prove the relationship to the endothelial structures on the basis of peritheliomatous and sarcomatous-like features In 1879 Wartman, after observing the presence of polyhedral cells, advanced the theory that they were probably derived from lymphatic endothelium His theory was accepted by many for a period of time, but the pendulum was kept in constant motion and, in 1912 Weishaut and a little later Moral, agreed on the idea that the ramus of the mandible probably furnished the peculiar embryonal material that is often included in these tumors This entertaining theory might furnish the origin of the tumor but does not lend itself to the complex differentiation that later occurs

Stein and Geschickter in a study of the pathological material at the Johns Hopkins Hospital referred to above and also a study of tissue cultures of tumors of the mixed type grown in vitro came to the conclusion that the active proliferating tumor element is an elongated basal cell that transforms into a more cuboidal or columnar type These types of cells are frequently seen in the organs of the embryo This theory may explain the origin of the tumors on an embryological ground. It has been demonstrated that the salivary glands result from an out-pouching of the buccal epithelium in the embryo Outlying cords or strands of glandular epithelium invade the connective tissue of the capsule and may be responsible for the beginning of the neoplastic process.

In this as well as other series of the cases the parotid gland is much more frequently the site of mixed tumors than the other salivary glands the submaxillary and the sublingual. Lowenkron, in 1930, called attention to the definite lack of encapsulation of the parotid during development He as well as others, stated that the parotid gland in its early stages lacks the specialized fibrous tissue capsule that is noted in the submaxillary and sublingual glands However, this is not true at a later stage when the parotid has a very definite fibrous tissue capsule, except over the most medial part of the retromandibular lobe Lowenkron mentioned the probability that the epithelial cells of the parotid may invade the mesenchymal tissue rather profusely in the region of Meckel's cartilage. From this it may be supposed that the epithelial tissue of the gland from the very first is closely associated with the precartilaginous part of the mandible

Messe Delamare Poirier, and Cuneo noted the ease with which embryonic lymph nodes were invaded by the epithelium of the parotid They stated that it was the outlying glandular elements of the embryonic parotid which normally retain the greatest growth potentialities and are most active also that the surrounding connective tissue probably stimulates the epithelial cells to react and to proliferate It was their notion that this fact could furnish the basis of the composite tumor containing both epithelial and connective tissue derivatives, i.e., acini and myxomatous tissue and cartilage

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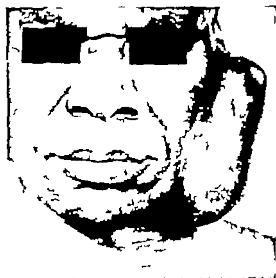


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PATHOLOGY

Mixed tumors of salivary tissue are rather definite clinical entities They present a firm elastic, ovoid or nodular characteristic surface the cut surface reveals varying types of tissue, depending upon whether the epithelial or connective tissue predominates A preponderance of epithelial tissue gives a reddish color

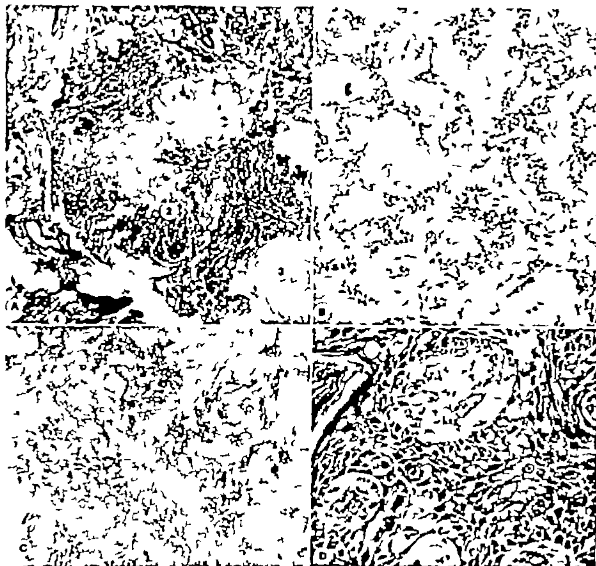


Fig 324 A D

A. Various histological types of mixed tumors, salivary tissue in some tumors.
(1) Mixed tumor showing variable types of tissue and poorly developed acini
(2) Strands of epithelial cells
(3) Myxomatous tissue
(4) Cartilaginous tissue

B Mixed tumor of parotid gland shows gland acini and strands of epithelial cells interspersed among mucoid connective tissue

C Mixed tumor parotid gland, showing nests and isolated epithelial cells interspersed between dense connective tissue. Little evidence of parenchyma remaining This type of tumor grows very slowly

D Mixed tumor parotid gland attempted acinar formation and papillary projections Some adenocystic like structures.

The tumor is separated from the normal gland by a distinct capsule although occasionally small finger-like projections protrude between the lobulations of the gland. On cross section Myxoid tissue or connective tissue produces translucent or grayish white appearance The tumor may be rather friable and easily broken apart and may show rather distinct lobulation

rger tumors may spontaneously break down the center due to insufficient blood supply, :h the formation of a resultant irregu cyst. Papillary formations are occasionally ted in the cyst which may be the seat of ıre active proliferation and malignancy Fre ently such tumors show infiltration of the ɔsule

cells which are interspersed in mucoid connec tive or cartilaginous tissue. The epithelium displays a great variability from adenomatous alveoli and gland acini to narrow strands or masses of flat compact epithelium of the basilar type, and small alveoli lined with cuboidal cells, which may be flattened so as to resemble lymph spaces lined with epithelium Nests of



Fig. 324 E-F

E. Mixed tumor parotid showing embryonic connective tissue
F Mixed tumor parotid containing fibromatous elements.

squamous cells may appear in many tumors and some show pearl formation, whereas, in other sections glandular acini predominate with rather distinct adenomatous tissue

Basal cell like lesions with connective tissue or hyaline stroma are observed in a small group of tumors and may be seen near the surface or in the capsule of larger growths and are frequently associated with adenocystic like structures The cells in such tumors are small cubical, or spindle with hyperchromatic nuclei, and are arranged in narrow cords that anastomose with one another or may form thin, flat strands.

ISTOLOGY

As the name suggests mixed tumors are of a omplex structure composed of epithelial ele nents in the form of alveoli, cell strands or liffuse masses, interspersed in mesoblastic tisue made up of variable amounts of cartilage, ıyaline, or myxoid connective tissue or mu ous tissue (Fig 324 A–F) In most cases one rea of the tumor has a preponderance of one lement and other areas show preponderance of other elements with no uniformity of pattern

Some tumors present columns of epithelial

Foote and Becker have recently described a *muco-epidermoid variant. It arises from the* duct epithelium and has a characteristic histological structure composed of two elements, squamous cells and tumor cells that produce mucin The latter may be the origin of cysts This type makes up approximately 5 per cent of the entire group of mixed tumors The malignant potentiality depends on the more cellular element which may break through the capsule and invade contiguous structures. evidence of low grade malignancy Our cases were observed only in the parotid

MALIGNANT TRANSFORMATION

Malignant transformation of mixed tumors is recognized by all students of this disease It is frequently difficult to differentiate between benign mixed tumors and ones that have undergone malignant change (Table 24)

The diversified histological picture of mixed tumor renders the establishment of satisfactory criteria of malignancy almost impossible. In the same tumor there may be both cell types of differentiation (mesodermal and ectodermal) in one area and one cell type of differentiation in still another Also there may be invasion of the capsule but since the capsule may be rather indefinite it is difficult to establish capsular invasion as a criterion of malignancy Combined metaplasia, anaplasia invasive properties rapid growth or rapid recurrence following incomplete removal are all together indicative of malignant transformation (Table 25)

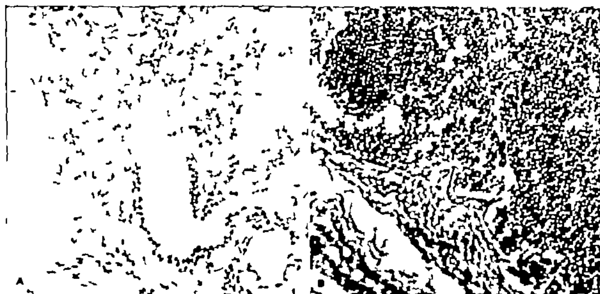


Fig 325

A Mixed tumor parotid gland showing well-developed acini, myxomatous changes, suggestive of teratoma. B Recurrence two years after removal strands of epithelial cells, myxomatous tissue dense infiltration with small round cells. Patient returned 2 years later with second recurrence causing paralysis of lower branch of facial nerve, evidence of malignancy as hard fixed mass. Treatment radical neck dissection and total resection of parotid gland *en bloc* Pathological report carcinoma of parotid gland lymph nodes negative

Although the original structure may be retained in recurrences, the secondary growth is definitely more cellular and malignant (Fig. 325 A and B) The secondary growth may have the appearance of sarcomas in which round cells or spindle cells predominate the so-called *sarcomas of the salivary glands* Occasionally when the recurrence contains large round pigmented cells, they are described as melanoma but lack the malignancy of true melanoma

Papillary adenocystomas are occasionally found in mixed tumors This tissue simulates that found in aberrant thyroid tissue however there are no follicles and no colloid. Papillary projections noted in the ducts are

Mixed tumors recur if incompletely removed immediately or after a period of months or years and they may recur many times.

Each time they recur the tissue is more cellular and more anaplastic but, in spite of multiple recurrence and local invasion, they seldom, if ever, metastasize as mixed tumors.

DIAGNOSIS

The patient usually gives a history of a slowly growing painless tumor, more frequently encountered in the lower pole of the parotid gland, and occasionally in the sub-

TABLE 24

MIXED TUMORS OF SALIVARY TISSUE—112 CASES

TYPE	NO. CASES	PERCENTAGE
		%
Parotid Gland Tumors	100	70 9 of total
Benign mixed tumors	75	75 of this group
Mixed tumors with malignant change	9	9 of this group
Submaxillary Gland Tumors	24	17 of total
Benign mixed tumors	18	75 of this group
Mixed tumors with malignant change	3	12 5 of this group
Aberrant Salivary Tissue Tumors	18	12 5 of total
Benign mixed tumors	*12*	*64 of this group*
Mixed tumors with malignant change	6	35 of this group

maxillary or sublingual glands The tumor is freely movable, as a rule, ovoid or nodular in shape, and of a firm and elastic consistency

TREATMENT

The treatment of mixed tumors of the salivary glands is complete surgical excision with a surrounding area of normal tissues. They do not respond to irradiation therapy in a satisfactory manner When the tumor is carefully excised with its capsule and an area of the tissue of ½ to 1 cm wide around it, recurrence is reduced to a minimum Recurrences are frequent amounting to as high as 35 or 40 per cent in some reported series of cases It is our definite feeling that this is due to inadequate removal The complications of excision are injury to the facial nerve and salivary fistula. Possible injury to the facial nerve accounts in a large measure to their inadequate removal by inexperienced and fearful operators The high

TABLE 25

TUMORS OF PAROTID GLAND—100 CASES

TYPE OF TUMOR		NO. CASES	PER CENT AGE OF TOTAL PAROTID TUMORS
			%
1 Mixed Tumors without malignancy (histologically benign)		75	75
2. Mixed cell tumors with malignant change		9	9
1) Those described as "malignant mixed tumors"	4		
2) Those described as mixed tumor with a definite type of malignancy			
a) with adenocarcinoma	1		
b) with carcinoma	4		
	9		
3 Other Benign Tumors		3	3
1) Papillary cystadenoma	1		
2) Lymphoid and fibrous tissue hyperplasia	1		
3) Lipoma	1		
	3		
4 Primary Malignant Tumors		13	13
1) Carcinoma	3		
2) Squamous Cell Carcinoma	2		
3) Adenocarcinoma	3		
4) Papillary Cystadenocarcinoma	1		
5) Intraductal Papilloma with early malignant change	1		
6) Fibrosarcoma	*1*		
7) Undifferentiated Carcinoma	2		
	13		

percentage of recurrences, together with the knowledge of malignant transformation in 12 per cent, should impress the operator of the need of thorough excision of all tumor bearing tissue These facts may have in the past, not sufficiently impressed the occasional operator

of the necessity for radical excision. Metastases from malignancy in recurrences of mixed tumors is slow. The mortality from malignancy in recurrences is 6–10 per cent. The technic of surgical removal will be discussed in detail with that of the treatment of malignant lesions.

Adenomas and Cysts

Adenomas of the salivary glands are not frequent. They begin as small encapsulated nodules of gland tissue and are thought by some to be due to congenital displacements. They may resemble fetal adenomas of the thyroid in their tendency to become cystic and, after a period of time, undergo malignant transformation.

They are more frequently encountered in the upper lobe of the parotid and are infrequently encountered in the submaxillary or sublingual glands. They occur as an encapsulated solid or cystic mass, and they may be found in the substance of the gland or near the surface. When the tumor is discovered it may be the size of a pea to an English walnut. Their growth is very slow. On section, the cut surface may reveal a solid or cystic tumor composed of reddish gland tissue lobulated by transversing septa, and some may contain minute cysts.

HISTOLOGY

Microscopically the structure is alveolar with a reproduction of the acini of the glands and papillary or cystic formations. The stroma, unlike that of mixed tumors shows an absence of mucoid or cartilaginous deposits. The cysts frequently contain papillary projections similar to those seen in aberrant thyroid tissue.

TREATMENT

The treatment of adenomas or cysts of the salivary glands is surgical excision, together with an adequate area of surrounding normal tissue. Recurrence will be almost nil following adequate surgical removal.

Malignant Tumors of Salivary Tissue

Malignant tumors of salivary tissue may be either primary or secondary, the latter developing in mixed tumors, cysts or adenomas.

In the series of cases from the Johns Hopkins Hospital reported by Stein and Geschickter the incidence of malignancy in parotid tumors was 17 4 per cent. In the present series, the incidence of malignancy is 24 per cent in all salivary tissue tumors whether arising in aberrant or in normal locations. Fourteen per cent *of the malignancies developed in a previously* normal gland. Ten per cent of the malignancies developed in a mixed tumor that had been present for several years and had taken on increased activity or in a patient following

TABLE 26

Malignant Salivary Tissue Tumors

		Total No. Cases	Total No. Malignancy
Parotid Gland			%
Stein and Geschickter		241	42—17 4
Ward-Hendrick Lacy		100	
Primary malignancy	13—13%		
Malignant mixed tumors	9— 9%		22—22
Submaxillary Gland		24	
Primary malignancy	3—12 5%		
Malignant mixed tumors	3—12 5%		6—25
Aberrant Salivary Tissue		18	
Malignant mixed tumor			6—33 3
Total		383	77—19 8
Total malignancies in present series			24

removal of a mixed tumor from one to several times (Table 26).

All salivary tissue tumors removed must be carefully scrutinized and examined microscopically. It has been our experience that not uncommonly malignancy has been found in cysts, adenomas, and mixed tumors previously unexpected on clinical examination. For this reason a wide margin should be given all salivary tissue tumors at operation.

Primary Malignant Tumors

Primary malignancy of the parotid gland, as a rule begins in the upper pole or in the

retromandibular lobe (Fig 326 A and B) There is a history of rapid growth, the lesion being present for months in place of years, as in mixed tumors. Primary malignancy is more commonly encountered in older patients, the average age being 55 years however, four cases were under twenty years of age two were under two years one was five, and the fourth was seventeen years of age

Pain developing within a short period after the tumor is observed is due to rapid expansion within the capsule and pressure over the sensory nerves. In the later stages, the pain is intense The facial nerve is involved early in about 35 per cent with resulting paralysis of the innervated muscles (Fig. 327 A B C) more commonly the lower branches are affected first The tumor is firm to stony hard, not encapsulated and early invades the surrounding structures and becomes fixed to the skin bone, and adjacent gland This rapid invasion was observed in a fifty year-old white female who came in because of pain in the right jaw A diffuse firm and immobile tumor was present in the *retromandibular* lobe of the parotid gland. The patient complained of inability to open her mouth sufficiently to masticate food and of pain on swallowing X ray examination revealed a destructive process involving the ramus and body of the mandible on the side of the tumor (Fig 328 A–C) Biopsy revealed an undifferentiated carcinoma of the parotid gland.

The rapidity of growth of primary parotid tumors may give the impression of an inflammatory lesion When malignancy of either the parotid gland or submaxillary gland is suspected the lymph nodes in the immediate area together with cervical and supraclavicular nodes should be carefully examined for metastases. Primary malignancies of the parotid or submaxillary gland and secondary malignancies to a lesser degree, metastasize not only to the regional nodes, but to the lungs and bones or osseous system When the cervical nodes are involved, x ray examination of the chest should be made, as we have two patients with lung metastasis

When there is a history of a primary tumor of the parotid and especially when the tumor

TABLE 27

DIFFERENTIATION BETWEEN BENIGN AND MALIGNANT SALIVARY TISSUE TUMORS

HISTORY	BENIGN TUMORS	MALIGNANT TUMORS
Clinical History		
Rate of growth	slow in years	rapid—months
Sex	no essential difference	more frequent in females
Age	between 20 and 45 years of age	average 55 years of age
Pain	usually absent	invariably present early
Physical Examination.		
Fixation	freely movable in the superficially located more limited movement of the ones developing in substance of the gland	may be fixed to skin, deep structures, and bone
Facial Nerve paralysis (parotid tumors)	unusual	common in 40% of the cases
Consistency	firm, cystic, nodular	may be stony hard
Gross Pathology	well circumscribed and contained in capsule	no capsule, diffuse invasion of contiguous tissue and bone
Microscopical Pathology	wide variety of cell patterns and myxomatous stroma	adenocarcinoma alveolar carcinoma, atypical carcinoma, showing round or spindle cell
Metastases	never	frequent lymph nodes, lungs, and osseous system

has been present for a period of months, a roentgenological examination should be made to determine whether there is bone involvement of the zygoma, mandible, or base of the skull, also a sialogram may be useful in determining the type and location of the tumor A sialogram is an x ray film made after injecting



Fig 326. Carcinoma right parotid gland

A. Ovoid tumor upper pole parotid gland. History of short duration

B Cross section of tumor shows infiltration of capsule at 1" 2," papillary adenocarcinoma.

lipiodol through a small canula inserted in Stensen s duct (See paragraph on technic) Sialograms are helpful in differentiating tumors that lie in the vicinity of the gland and not involving it This procedure was useful recently when a fifty five-year-old bank executive presented himself with a tumor just below the maxilla about two inches in front of the ear It had the appearance of a rapidly developing parotid tumor Sialograms were entirely normal indicating the tumor to be extra glandular At operation, a lymphosarcoma was found in the cheek above Stensen s duct and attached to the undersurface of the superior maxilla.

Histologically there are three main varieties of primary carcinoma of the salivary gland the adenocarcinoma the alveolar carcinoma and the atypical carcinoma, showing a tumor composed of spindle or round cells (Ewing) The adenocarcinoma may have a papillary or alveolar form the former developing from the ducts, and the latter from the acini. The alveolar type reproduces more or less exactly the acini of the gland. Figure 329 A–H shows photomicrographs of several types of primary malignancies of salivary tissue.

Cylindromas of the parotid have been frequently described as a form of adenocarcinoma. They are composed of cords or masses of epithelial cells, including spaces filled with mucus. The connective tissue around these strands may show hyaline or mucoid degeneration. The structure bears a relationship to basal cell carcinoma of the adenocystic type.

The atypical type of carcinoma, composed of round or spindle cells, has been described as round cell sarcomas There were two such tumors in this group The prognosis is rather good better than sarcomas encountered elsewhere in the body

Malignant Mixed Tumors

Malignant mixed tumors show invasive characteristics, both in a tumor that has not been operated upon previously and one that has been removed incompletely They develop slowly and do not have the rapid growth noted in the primary malignancies. As mixed tumors are more commonly noted in the lower pole of the gland, usually malignancies arising in mixed tumors develop in this area There may be a history of the presence of a mixed tumor for a number of years with more recent rapid in-

crease in size, development of pain, fixation of the tumor and involvement of the lower branches of the facial nerve. On the other hand there may be a history of repeated removal of a mixed tumor with a recurrence developing immediately or several years after the last operation The recurrence is often firm immobile and painful. It has been pointed out that tumors seemingly involving the entire gland are more vicious than those developing as ovoid or pendant tumors superficially located It was noted by Hertzler that the former were possessed of a cellular activity involving the whole tumor whereas in the



Fig 327 Primary carcinoma right parotid gland

A Fifty two-year-old white male. History enlargement right parotid gland, 8 months duration. Severe pain in parotid gland area and external auditory canal. Marked trismus. Paralysis lower branches facial nerve. Ulceration over most prominent part of tumor Frozen section anaplastic carcinoma parotid gland.

B Partial destruction of ascending ramus, right mandible

C Radical neck dissection Total excision parotid gland. Resection of involved mandible Returned 18 months later with intracranial metastases. No local recurrence

latter the activity was limited to a small region of the tumor the remainder being an unchanged mixed tumor

The younger the patient, the more rapid the growth as illustrated by a colored male eighteen years of age, having a mixed tumor of the submaxillary gland for three years. The tumor had been removed elsewhere and within a few months recurred. When *examined in the* clinic, there was a firm, fixed tumor of the left submaxillary region At operation, a mixed tumor with carcinomatous changes was found There was involvement of the immediate lymph nodes. A radical neck dissection was done on the side of the tumor there has been no evidence of recurrence for four years. Recurrences may be in the form of a large tumor which infiltrates and involves all of the surrounding tissue, including the skin, with or without ulceration Or occasionally there may be small nodules beneath the skin which are movable and not attached to the deeper structures Since these tumors tend to remain local, even extensive recurrences are curable, a characteristic often distinguishing from the primary malignant type.

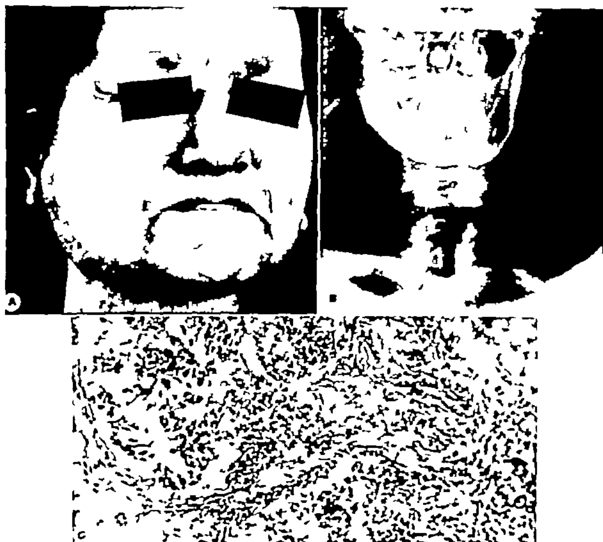


Fig 328

A. Carcinoma, right parotid gland, producing diffuse enlargement Pain functional disturbance lower branches facial nerve trismus.

B Roentgenogram, right mandible destruction of the ramus by anaplastic carcinoma parotid gland.

C. Photomicrograph undifferentiated carcinoma. Nests and strands of epithelial cells, varying in size with large hyperchromatic nuclei round cell infiltration. Connective tissue stroma contains spindle cells.



Fig. 329 A–D Histological types primary salivary tissue cancer

A. Photomicrograph squamous cell carcinoma, parotid. Nests and strands of epithelial cells, varying in size and shape. Hyperchromatic nuclei Epithelial pearl present.

B Papillary cystadenocarcinoma, parotid gland. Papillary projections and cystic areas, present. Stroma infiltrated with epithelial cells in strands and nests. Cells vary in size and staining characteristics.

C. Fibrosarcoma, submaxillary gland. Photomicrograph shows spindle and round cells with deep-staining nuclei. Stroma sparse Some round cell infiltration

D Adenocystic basal cell carcinoma submaxillary gland. Photomicrograph shows adenocystic nests of cells. Poorly formed acini Moderate amount of fibrous tissue stroma.

HISTOLOGY

It is often difficult to distinguish between benign mixed cell tumors and those containing areas of malignancy In the latter there may be little change in the epithelial or connective tissue cell patterns from those seen in a primary benign tumor or in a recurrent tumor There may be little evidence of invasion of the connective tissue stroma In malignancy the



Fig 329 (E–H)

E. Round cell sarcoma submaxillary gland Photomicrograph dense infiltration with plump round cells with hyperchromatic nuclei. Stroma sparse

F Photomicrograph parotid gland tumor Recurred three times after incomplete removal elsewhere Metastasis to lymph node. Epithelial cells forming poor acini. Cells vary in size and have hyperchromatic nuclei

G Papillary adenocystoma parotid gland.

H. Muco-epidermoid tumor parotid gland composed of squamous and tumor cells that produce mucin

cells are usually larger and more deeply staining than in benign mixed tumors. There are other cases, however, where the malignant process is unquestionable, as evidenced by rapid cellular proliferation and invasion with great variation in size and shape of cells. In the light of the frequently puzzling microscopic picture one must always consider the clinical findings and the occasional lymph node involvement in making a diagnosis of malignancy.

After one or several recurrences, all evidence of a mixed tumor may be absent and the microscopic examination shows deeply staining large cells with or without alveolar arrangement, the cells may become oblong or spindle-shaped. These secondary malignant tumors show rapid invasion of the surrounding capsule and other tissues, but seldom metastasize.

TREATMENT

Since practically all salivary gland tumors are not sensitive to irradiation therapy their treatment becomes a surgical problem. Occasionally when a patient refuses operation or when the disease, if malignant, is so extensive that operation will not give reasonable chance for cure, irradiation is used for palliation.

The chief danger of any operation in the region of the parotid gland is injury to a part or all of the facial nerve. It is for this reason that many surgeons, inexperienced in operating in this area, refrain from doing radical procedures when indicated and often refuse even to remove benign tumors adequately in their earlier stages. The danger of small tumors growing to large size and subsequently injuring the facial nerve plus the danger of these tumors developing secondary malignancy renders it desirable to remove all tumors from the parotid or the other salivary glands. Carefully planned surgical procedures should not injure the nerve when removing small tumors. There is danger of injuring some of the branches of the nerve when excising large benign tumors for the (benign) tumor may have displaced the branches of the nerve, making their identification difficult. When removing cancer of the parotid gland, a radical operation is necessary, and the patient must be informed that the nerve will probably be cut or partially removed along with the malignancy and node bearing tissue. Paralysis of the face, however, is outweighed by the chance of cure and relief of pain. The patient should be reassured also that fascial strips may be inserted at the primary operation or at a subsequent date to lift the angle of the mouth and the lower eyelid, removing disfigurement to a greater or lesser degree.

Our plan of anesthesia is as follows. The patient is given an induction anesthesia with pentothal sodium and then an intratracheal tube inserted. Both pentothal sodium, intravenously and nitrous-oxide oxygen anesthesia by inhalation through the intratracheal tube are continued throughout the operation. The elimination of ether from the anesthesia makes it possible to use the electro-surgical current, an indispensible adjunct to the surgeon's armamentarium.

The entire side of the face and neck should be prepared and draped in the operative field, so that whatever procedure is necessary may be executed and any muscular twitchings caused by manipulation of the facial nerve may be watched. Picking up structures suspected of being the nerve or one of its branches will cause stimulation of the supplied muscle.

Technic of Operation for Benign Parotid Gland Tumors

Incisions for surgical approach to the parotid gland are of two main types. One, emphasized by Blair and Patey (Fig. 330), begins at the level of the zygomatic arch in front of the ear and extends downward around the lobe of the ear and back of the angle of the jaw, then turns downward and forward paralleling the lower border of the mandible about 2 cm below it and as far forward as the external maxillary artery and vein. The other incision, advocated by Sistrunk, Adson and Ott, and Hamilton Bailey, is similar to the first with the addition of a second incision beginning on the first at the lobe of the ear and running

backward at an obtuse angle up over the mastoid process.

Hamilton Bailey (1941) called attention to the need of revision of the surgical anatomy of the parotid gland. We quote, "The main trunks of the facial nerve are the temporal, facial, and cervical facial divisions and embrace the isthmus, but no part of the facial nerve runs actually within the gland substances rather the facial nerve should be looked upon as the meat within the parotid sandwich *its main divisions lying between the* deep and superficial lobes but, because of the small size of the deep lobe the outlying sub*divisions of the nerve rest between the super*ficial lobe and the masseter muscle. (Fig 331)

Bailey continues by saying "The old con*ception of the parotid gland being constituted* of a main mass of various projections passing deeply into surgically inaccessible and vulnerable recesses with the facial nerve transversing its parenchyma should pass as also should the teaching of that prince of surgical anatomists Sir Frederick Treves, who taught that it was a surgical impossibility to remove the parotid gland in its entirety On the contrary complete extirpation of the gland with preservation of the facial nerve is a feasible undertaking for which there are definite indications"

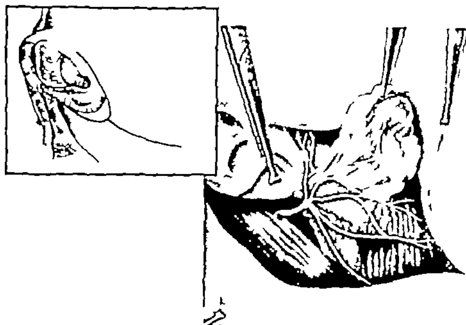


Fig. 330. Insert shows incision used for removal of benign tumors of the parotid gland as advocated by Sistrunk Adson and Ott and Bailey" care being exercised to make the angle of the V-shaped incision an obtuse one to prevent necrosis. Figure shows lower pole containing tumor dissected upward off of branches of facial nerve. Isthmus of the gland extending around mandible to retromandibular lobe.



Fig 331 Schematic drawing showing larger superficial lobe and smaller retromandibular lobe joined by isthmus. Branches of facial nerve on each side of isthmus (Redrawn from Hamilton Bailey British Journal of Surgery)

Before attempting to remove the tumor the facial nerve or one of its branches should be identified. The facial nerve can be most conveniently found at two locations The inframandibular branch emerges from the lower margin of the parotid gland and passes down behind the angle of the jaw (Fig 332) The nerve turns upward across the mandible and crosses the external maxillary artery and vein Here the nerve may be picked up and followed

back beneath the spuerficial lobe of the parotid gland to the main trunk of the facial nerve. This technic has been emphasized by Sistrunk and again referred to by Adson and Ott Hamilton Bailey prefers to pick up the main trunk and retromandibular lobes (see illustration 331 from Hamilton Bailey) After identifying the main trunk of the nerve, the dissection is carried down along the anterior border of the sternomastoid muscle, and the external carotid



Fig. 332. Insert shows incisions for removal of small benign tumor of the parotid gland
A. Blair and Pady
B Sistrunk Adson and Ott, and Bailey
C. Incision through skin and subcutaneous tissue extending down to parotid gland. Small branch of facial nerve running over surface of tumor This is unusual
D Method of demonstrating facial nerve. Incision is carried along the lower edge of the mandible to the crossing of the facial artery and vein The mandibular branch of the facial nerve is found running parallel to the lower border of the mandible It is followed posteriorly until it joins the main branch of the nerve where it emerges from the stylomastoid foramen anterior to the sternomastoid muscle and posterior to the capsule of the parotid gland. The tumor can then be dissected out with little danger of injury to any of the major branches of the facial nerve. Adequate normal tissue is removed around the tumor to prevent recurrence. (Redrawn from Sistrunk Adson and Ott Archives of Surgery)

of the facial nerve as it emerges from deep in the neck between the mastoid process and the capsule of the retromandibular lobe of the parotid The main trunk is identified and followed forward, it is found that the branches separate and pass around the isthmus of the parotid gland which connects the superficial artery identified and ligated This early ligation of the artery reduces hemorrhage in the operative field making continued identification of the nerve and its branches much easier This is a point stressed also by Hamilton Bailey and J W Hendrick

After the main trunk or the inframandibular

branch of the nerve has been identified the parotid gland is lifted up and removed, as the branches of the nerve are kept in sight and carefully protected. In dealing with small tumors a lesser amount of the parotid gland is taken away than with larger tumors. It is always important, as stressed above, to take at least a centimeter margin of normal parotid gland around the tumor McFarland has shown that there are a larger number of recurrences after the removal of small sized tumors than after the removal of large ones This is probably due to the fact that inadequate exposure is given when removing small tumors and the semisolid mass of cells is extruded from the capsule and the limitations of the capsule are lost in the hemorrhagic field

D State (1949) confirmed McWhorter's findings by dissections on the cadaver He then devised a unique technic for superficial lobectomy and total parotidectomy without injury to the seventh nerve By defining the anterior border of the gland then dissecting posteriorly between it and the facial nerve the only part of the gland substance that is entered is the thin isthmus. This technique is used to facilitate the dissection. However if the tumor occupies the isthmus, the transection of this part of the parotid is avoided and the whole gland is removed intact. This technique results in more handling and trauma to the facial nerve with a consequent longer period before recovery of its functions occurs.

State advocates this radical procedure for all solid tumors of the parotid gland for the following reasons high recurrence rate of these tumors, the possibility of multiple tumors (one in his series of 11 cases) and the possibility of multiple foci of origin of mixed tumor as suggested by Ewing He also emphasizes the importance of not trying to determine the extent of the tumor or of violating the pseudo-capsule

The relationship of the tumor in the gland to the facial nerve and its branches depends entirely upon the position of origin of the tumor Should it have origin in the superficial lobe, it will lie over the nerve, sometimes depressing it tightly against the masseter muscle or mandible or should the tumor lie just back of the ascending ramus of the jaw the nerve may be pushed deeply behind the jaw One of our cases was a young woman in her early thirties, having a supposedly small tumor presenting just back of the ascending ramus and above the angle of the jaw At operation, it was difficult to locate the nerve, but at no time was it injured. After the tumor was removed with its capsule, the nerve was found pressed against the masseter It lay in the hollow formed by the tumor where it was seen to divide and spread out, the branches coming up over the masseter muscle On the other hand should the tumor begin in the posterior lobe or isthmus of the gland the nerve may be pushed superficially and encountered running over the tumor itself (Fig 330) Preservation of the nerve then requires a good deal of careful dissection and protection Tumors located high up under the lobe of the ear are better exposed by elevating the tragus with sponge forceps, a skin hook or an Allis s clamp

When the retromandibular lobe is involved, a helpful maneuver is to rotate the head to the opposite side and elevate the angle of the mandible, increasing the working space and aiding in dislodging the tumor from its bed deep in the retromandibular lobe.

To remove the deep or retromandibular lobe the facial nerve is retracted by passing umbilical tape around it and its branches and making gentle tension. The lobe is then separated from the great vessels of the neck and from the pharyngeal wall. Previous ligation of the external carotid artery reduces arterial bleeding most of the bleeding then is venous, coming from the tributaries of the external and internal jugular veins Hamilton Bailey suggests the ligation of the jugular vein above and below its juxtaposition to the deep lobe a maneuver which he says is rarely necessary We have found that the deep lobe can be pushed laterally by an assistant s finger in the mouth making pressure on the lateral pharyngeal wall Care must be taken, particularly with the adherent tumors, not to injure the pharyngeal wall.

The use of a galvanic current stimulator is of value in identifying branches of the facial nerve when the main trunk cannot be adequately exposed. The stimulator is particularly advantageous while operating for recurrent tumors where there is a bed of dense adhesions, sometimes obscuring accurate differentiation of the filaments of the nerve. The electrodes of the galvanic current stimulator are sterilizable and are kept in the operative field for immediate use. Any unidentified bit of tissue can be touched with the electrode and if nerve, the supplied muscle will contract. This technic is also serviceable in identifying the cut ends when the nerve is accidentally severed. The cut ends can then be picked up and re-sutured with very fine vitallium wire.

In handling large tumors it is often helpful to carry the incision deeply along the anterior border of the sternomastoid muscle and anterior border of the mastoid process to expose the origin of the posterior belly of the digastric muscle. The styloid process may be felt and is a useful landmark to keep one away from the internal jugular vein and internal carotid artery which lie beneath both the styloid process and the posterior belly of the digastric and stylohyoid muscles.

Recurrent tumors present more difficult operative technical problems. Dense adhesions render identification of the branches of the facial nerve hazardous. Recurrence may indicate malignant change in the tumor and for this reason a much wider margin of tissue is taken along with the growth itself.

It is our feeling that any recurrent tumor having the appearance of malignant transformation or any other tumor, primary or secondary, suggesting carcinoma or sarcoma, should have a biopsy to guide in the planning of the more radical operation. Biopsy is safe and any theoretical danger of spreading the disease is outweighed by the value of an accurate diagnosis. Since it is often difficult for the most experienced pathologist to interpret accurately a frozen section of a salivary tissue tumor, it is preferable to wait for a permanent section for an accurate pathological diagnosis. Also, the clinical picture must be taken into consideration in evaluating benignancy or malignancy. When it is determined that the pathological process is malignant, a much more radical procedure is necessary than in the case of even large benign neoplasms. Not only should the whole parotid gland be removed for malignancy but a radical neck dissection should be done at the same time. Complete removal of the parotid gland, particularly when involved by cancer, often necessitates the sacrifice of the facial nerve or any of its branches. Since secondary malignancies usually begin in the lower part of the superficial lobe it may be possible to save the temporal facial divisions and thus give the patient protection to the eye by not paralyzing the eyelid muscles. In some cases even this upper branch must be sacrificed. As mentioned above, subsequent fascial transplants will help to correct facial paralysis. The patient should be warned of this complication and reassured that the value of the radical operation outweighs the loss of function of one side of the face. No doubt conservative surgery in an attempt to save the facial nerve in malignant disease accounts for many of the recurrences reported.

Technic of Operation for Malignancy of the Parotid Gland

Having determined by clinical analysis and biopsy that malignancy exists the patient is prepared for a radical neck dissection, together with removal of the entire parotid gland en bloc.

One of the two incisions described above is used and extended downward, parallel and below the mandible to the midline of the chin (Fig 333). A second incision is dropped vertically from the middle of the first down across the sternomastoid muscle to the middle of the clavicle. Skin flaps are dissected back on all sides, together with the platysma muscle. The neck dissection is begun at the clavicle and carried upward. The lower end of the sternomastoid muscle is isolated and cut between clamps. Bleeding points are controlled either

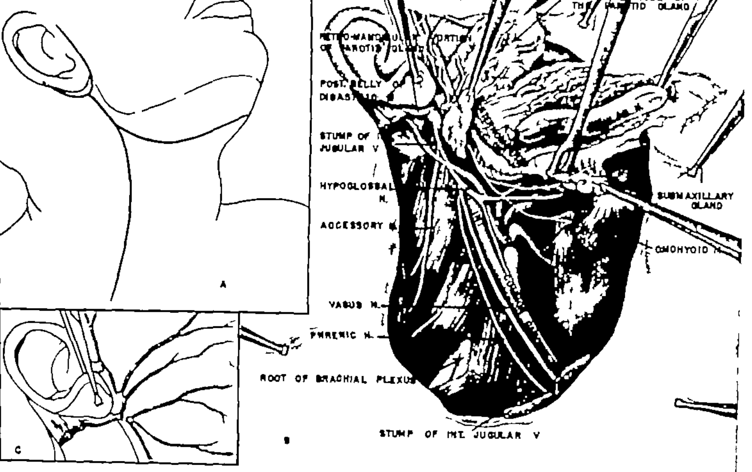


Fig 333 Radical removal of parotid gland and radical neck dissection for carcinoma

A Incision begins at the level of the zygomatic arch in front of the ear and extends downward around the lobe of the ear A second incision begins at the mastoid process and extends down to join the first at an obtuse angle and is continued downward parallel and below the mandible to midline of the chin. A third incision is dropped vertically across the sternomastoid muscle to the middle of the clavicle

B Skin flaps are dissected back together with platysma muscle. Dissection is begun at the clavicle and carried upward. The sternomastoid muscle is severed between clamps. Jugular vein is ligated with four silk ligatures and severed between the two central ones. Dissection is carried upward removing sternomastoid muscle jugular vein omohyoid muscle, the lymphatic-bearing fascia, from midline in front to trapezius behind. The spinal accessory nerve is preserved. External carotid artery is doubly ligated The posterior belly of the digastric muscle and the stylohyoid muscle are severed from their attachments to the mastoid and styloid processes, respectively The upper end of the jugular vein is ligated with four silk ligatures and severed between the two central ones. The submaxillary gland and its contained lymph nodes are removed. The main trunk of the facial nerve is identified and traced forward. The facial nerve is pushed forward and if not involved by the tumor its branches can be preserved. Usually the nerve is removed when operating for cancer

C If possible, the zygomatic and infraorbital branches are left to avoid paralysis of eyelids, if involved by the tumor the entire facial nerve is removed. The retromandibular lobe is excised along with the superficial lobe off the masseter muscle. If the ascending ramus of mandible and masseter muscle are involved the involved area is removed also

with the clamp electrocoagulation method or by ligature.

The jugular vein, just above the clavicle, is then ligated by four medium black silk ligatures and cut between the two central ones. The dissection is carried up the neck, taking the sternomastoid muscle, jugular vein, the omohyoid muscle, and all of the lymphatic bearing fascia from the clavicle to the jaw and from the midline in front to the border of the trapezius muscle posteriorly. The spinal accessory nerve is picked up as it emerges from the posterior edge of the sternomastoid muscle at about the junction of the upper and middle third. The nerve is then followed through the muscle, the posterior fibers of the muscle being cut away to give adequate exposure. Keeping the nerve in view the upper end of the sternomastoid muscle is severed at its origin on the mastoid process. The muscle and overlying contents are now dissected forward, the spinal accessory nerve again picked up and carried upward to the point where it dips beneath the posterior belly of the digastric muscle to lie along the jugular vein. The fibers of the posterior belly of the digastric muscle are readily identified as they come from the digastric groove on the undersurface of the mastoid process and pass diagonally downward beneath the fibers of the sternomastoid muscle which run in a slightly different and more perpendicular direction. The posterior belly of the digastric muscle is then cut and the stylohyoid muscle lying beneath it is also severed from its attachments to the styloid process exposing the upper end of the jugular vein which is then separated from the spinal accessory nerve. The jugular vein is then ligated with four ligatures of medium black silk and cut between the two central ones.

A maneuver which facilitates separating the lower end of the sternomastoid from the jugular vein is to identify the omohyoid muscle and follow it with the finger down beneath the sternomastoid muscle, lifting the latter upward. The omohyoid muscle passes over the internal jugular vein. When disease is adherent in this area the omohyoid muscle protects the jugular vein from injury. The posterior belly of the digastric muscle is identified at the hyoid bone anteriorly, or at the mastoid process posteriorly and followed forward or backward, dissecting away adherent masses until the jugular vein is adequately exposed, ligated, and severed.

After dissecting up the neck the operator turns his attention to the submaxillary triangle which is cleaned of its contents. The submaxillary duct is cut and ligated and the dissection continued backward to reach the already dissected posterior neck. All bleeding points are clamped and either ligated or coagulated.

The facial nerve is identified as previously described as it emerges from the base of the skull and divides to surround the isthmus of the parotid gland. All branches of the facial nerve adjacent to the cancer are sacrificed. The dissection is then carried forward, taking the posterior lobe from behind the mandible and the superficial lobe off the masseter muscle. Involved portions of the masseter muscle, ascending ramus of the jaw or skin are taken with the specimen.

When there is no involvement of the skin, the wound is closed in layers with interrupted black silk. Suturing the skin flaps down to the neck obliterates dead spaces. Suitable drainage is established as follows.

A Penrose or cigarette drain is brought out the lower end of the neck incision and a long Penrose or cigarette drain placed from behind the ear to come out in the midline under the chin. This latter drain assures drainage posteriorly while the patient is reacting from the anesthesia and anteriorly after he is able to sit up the next day. On the second day, the posterior end of the drain is cut and the drain is pulled forward daily and out on the fourth or fifth day. The lower drain is also removed on the fourth or fifth day, depending upon the amount of drainage.

Treatment of Submaxillary Gland Tumors

Benign tumors are removed by excising the entire gland through an inframandibular in

cision The gland is as a rule, not adherent and is readily dissected free. In case the gland is adherent, annoying bleeding may be encountered beneath the floor of the mouth Such bleeding is controlled by temporary packing with gauze, or the vessels are caught in clamps and coagulated or ligated with silk Wharton s duct is found running backward to pass up onto the floor of the mouth around the posterior edge of the mylohyoid muscle Occasionally large below the mandible from beneath the tail of the parotid gland and turns up across the jaw and external maxillary vessels again to reach the lower lip

TUMORS OF ABERRANT SALIVARY TISSUE

Although salivary tissue tumors occur most frequently in the salivary glands, particularly in the parotid they are found also in the lips

TABLE 28

TUMORS OF ABERRANT SALIVARY TISSUE

LOCATION	TYPE	SIZE	DURATION	AGE AT ONSET
1 Hard palate left	Mixed cell tumor	1 cm.	4 yrs.	44
2. Hard palate left	Mixed cell tumor	1 cm.	3 yrs.	12
3 Hard palate left	Mixed cell tumor	3 cm	25 yrs.	8
4 Soft palate right	Mixed cell tumor	3 cm.	20 yrs.	35
5 Soft palate left	Mixed cell tumor	3 cm.	10 yrs.	16
6. Soft palate midline	Mixed cell tumor	3 x 5 x 1 cm.	1½ yrs.	28
7 Soft palate	Mixed cell tumor	involved almost entire palate	1½ yrs.	29
8 Above left eyebrow	Mixed cell tumor	1 cm.	1 yr	45
9 Upper lip left	Mixed cell tumor	1 7 x 8 cm.	2 yrs.	43
10 Lower lip left	Mixed cell tumor associated with hemangioma	3 x 2 cm.	4 yrs.	37
11 Cheek	Mixed cell tumor	3 x 4 cm.	4 yrs.	40
12. Behind right ear	Mixed cell tumor	1 x 1.5 cm	8 mos.	
13 Cheek below left eye	Embryonal Carcinoma arising from sal. tissue	2 x 2 cm.	6 mos.	8 mos
14 Cheek below right eye	Embryonal Carcinoma	2 x 1.5 cm.	2 mos.	1 yr
15 Wall of right nostril	Embryonal Carcinoma	1 x 2 cm.	1 yr	18 mos.
16. Rt. lateral pharyngeal wall	Sarcoma arising from mixed tumor		5 yrs.	39
17 Pharyngeal wall	Sarcoma arising from mixed tumor	4 x 5 cm.	10 mos.	60
18. Mastoid process of temporal bone	Carcinoma arising from salivary tissue	3 x 2 cm.	10 mos.	54

calculi are found in the neck portion of Wharton s duct or in the substance of the gland itself requiring complete removal of the gland

The occasional malignant tumor found in the submaxillary gland requires a radical neck dissection, as already described, exclusive of removal of the parotid gland The dissection extends from clavicle to mandible, and from midline in front to trapezius muscle in back, including the anterior posterior and submaxillary triangles The inframandibular branch of the facial nerve may be injured as it dips down cheeks, palate nares and pharynx, and on the skin of the face and neck We have had one patient a surgeon, who had a small salivary tissue tumor in the eyebrow and another patient a dentist who had a similar tumor in the skin over the left mastoid process.

Since the salivary glands arise from outgrowths of the primitive oropharynx, it is quite natural that aberrant salivary tissue tumors are found in the above-mentioned locations Ewing states "The lacrimal gland may also be included with the salivary organs in the

study of its tumors" (See Fig 450 and Chapt. XIV)

There are two explanations for the occurrence of aberrant salivary tissue tumors one based on Cohnheim's theory of embryonic rests, and the other based on the theory of metaplasia with reversion of the epithelium in a given area back to one of the primitive types (see Chapt X)

Clinical interest of aberrant salivary tissue tumors is in their differential diagnosis and treatment Since they are differentiated and behave similarly to salivary tumors found in their normal habitat they are not sensitive to irradiation Their treatment is surgical.

The differential diagnosis is made accurately only by microscopic examination. Small tumors in the skin or lips appear as rounded intracutaneous nodules with no special diagnostic characteristics Large tumors are firm, nodular and irregular One patient (Fig 165) with a recurrent salivary tissue tumor had telangiectases radiating from the center of the growth Microscopic examination revealed salivary tissue associated with hemangiomatous elements, accounting for the large number of dilated venules

In the mouth, the main characteristics that differentiate these tumors from others are (1) their slow growth (2) nodularity (3) slowness in ulceration (4) lack of pain, (5) epithelization over the tumor after biopsy a characteristic similar to ameloblastoma and adenocystic basal cell epithelioma This characteristic differentiates carcinoma and other malignant tumors which vegetate out through biopsy incisions. We have not had any salivary tissue tumors of the mandible although such are reported Several in our series have occurred on the upper alveolus and hard and soft palates (Fig 334 A–D) One elderly gentleman was referred because of a bulging of the left side of the soft palate, noted by his dentist The patient himself had experienced no symptoms. A clinical diagnosis of cyst had been made prior to admission. With the aid of a throat mirror a rounded tumor 1.5–2 cm in diameter was visualized on the upper aspect of the left soft palate The tumor felt firm The patient was a poor operative risk suffering from symptoms of advanced arteriosclerosis Also operation was not advised because of the possibility of leaving a perforation in the soft palate. Aspiration biopsy was performed on the basis of the clinical diagnosis of cyst anticipating that its contents could be evacuated and a sclerosing solution injected to obliterate it. Much to our surprise, the tumor proved to be solid and a small bit of tissue removed and subjected to microscopic study revealed a mixed tumor of the salivary tissue Three radon seeds of 3 mc. strength were inserted and the tumor shrank to less than a centimeter in diameter and remained quiet for the rest of the patient's life (two years)

Sufficient significance has not been attached to the malignant transformation of aberrant salivary tissue In 142 cases of salivary tissue tumors studied by us, 33.3 per cent of the aberrant salivary tissue tumors showed malignant disease A resumé of three cases in children under five years of age follows Two of these were reported previously by Ward and Shipley prior to this study and are not included in the 142 cases.

Case 1 White male child 2½ years of age, developed a tumor in the right nasolabial fold 2 months previous to admission to the clinic (Fig 335 A–D) The tumor was noticed accidentally by the mother while bathing the baby There was a firm freely movable tumor 1 cm in diameter The tumor was excised the pathological report was mixed cell salivary tissue tumor locally invasive. The patient returned to the clinic two months later with firm palpable preauricular lymph nodes and enlarged nodes in the upper jugular chain. Radon seeds were implanted in the preauricular nodes after biopsy and a radical neck dissection was done. The pathological report showed the same type of cell and cellular architecture noted in the original growth. The patient made an uneventful recovery and 8 months later was again seen in the clinic following an upper respiratory infection. There was some cloudiness in the roentgenogram of the right lung which was interpreted as pulmonary metastases. The patient was given roentgen therapy over the involved pulmonary field with prompt clearing up of the abnormal pulmonary shadows, suggesting that the pulmonary shadows were of infectious origin and not pulmonary metastases. However the patient died shortly thereafter

[*Case 2* was observed at the University of Maryland Hospital. The patient, a four year-old colored female gave a history of having injured the right side of her face and nose while playing followed by nose-bleed. Ten days later she again struck the right side of her face and her mother noted a tender firm mass below the right eye. During the next two months, the mass increased in size but was not painful (Fig 336 A-C).

On examination in the clinic it was felt that the mass was entirely independent of the injury. The mass was irregular in outline, measuring 3 x 2 x 5 cm. and appeared to be deeply attached and immobile. X-ray examination did not reveal any involvement of the para nasal sinuses. A biopsy was taken which appeared grossly to be sarcoma. Pathological diagnosis was malignant anaplastic tumor exact classification not

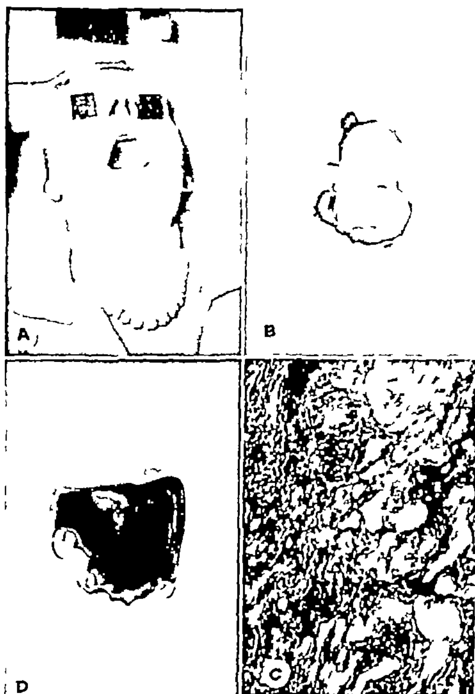


Fig 334

A. Mixed tumor aberrant salivary tissue, extending from midline to alveolar ridge 20 years duration

B Cross section of tumor

C. Photomicrograph Epithelial cells occurring in strands some forming acini Dense hyalinized connective tissue.

D Temporary prosthesis worn to protect wound until it was well healed There was no permanent defect

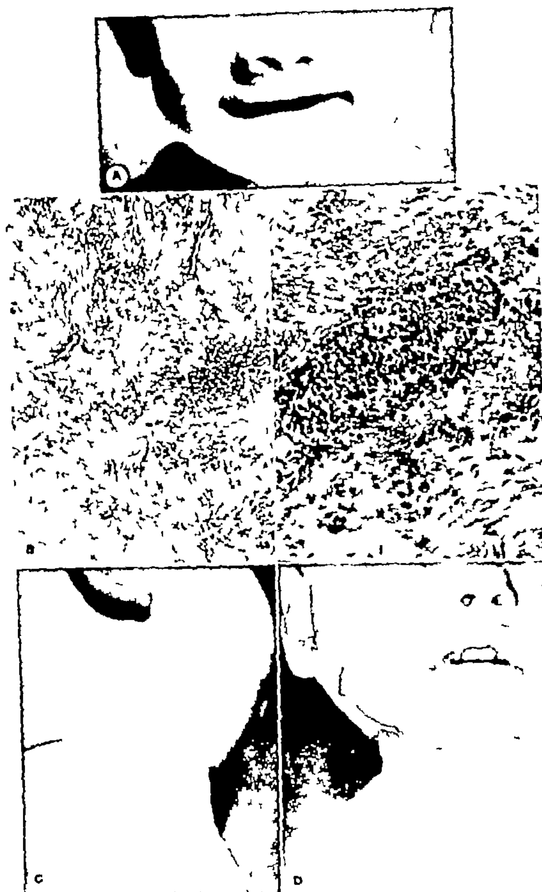


Fig. 335

A. Malignant aberrant salivary tissue tumor, right nasolabial fold.

B. Photomicrograph (low and high power) showing epithelial cells occurring in strands, nests, varying in size, shape, and chromaticity, some attempting acini formation. Moderate connective tissue stroma.

C. Metastases to lymph nodes at the angle of the mandible and upper jugular chain.

D. Scar of radical neck dissection. See text for details.

determined, but the tumor was thought to be of salivary tissue origin. The tumor was implanted with 38 mg of radium element in needles, giving a total dosage of 5966 mg hr







A B C

Fig. 336

A Photograph of 4-year-old colored female following treatment of tumor of the right cheek with irradiation B Defect closed with pedicle graft from right chest
C Photomicrograph of anaplastic malignant tumor — Note a more adenomatous arrangement than seen in Fig. 337 B (Courtesy Am. Jr Roent and Radium Therapy)

The wound broke down following irradiation. The necrotic tissue and bone was removed and the resultant defect in the right cheek was closed several months later by pedicle graft from the chest The patient has been followed in the outpatient clinic for six years and no recurrence has been observed

Case 3 (White female 2 years of age.) A small tumor was observed by the parents below the left lower eyelid when the baby was about 8 months old The tumor was removed surgically 2 months later The pathological diagnosis was embryonal carcinoma. Following the surgical excision the patient was given irradiation therapy both with radium and x ray There was a recurrence of the tumor four months later when the patient was referred to the clinic (Fig 337 A and B) Examination revealed a healthy female child about 2 years of age with a healed scar parallel with and about 3 cm beneath the left lower eyelid A mottled reddish





Fig 337

A. Photomicrograph of 2 year-old white male patient that had an anaplastic mixed cell tumor of the left cheek Treated elsewhere by surgery and Irradiation.

B. Photomicrograph showing invasion with large cells varying in shape size and chromaticity (B Courtesy Am. Jr Roent. and Radium Therapy)

swelling was noted below the inner half of the lower eyelid beneath which there was a hard fixed lump. No large cervical nodes were palpated.

The roentgenogram of the antrum and skull showed no evidence of bone involvement

It was felt that the tumor was radioresistant. At operation, the growth was found to have penetrated the nasal and maxillary bones. No line of cleavage could be obtained. Pathological examinations revealed a mixed structure of large masses of deeply staining cells, with round and oval spaces, suggestive of attempt at glandular formation Pathological diagnosis was low grade malignant tumor arising from aberrant salivary tissue

An interesting example of sarcoma developing in aberrant salivary tissue is that of a white man, aged forty-four, who four years previously had the left tonsil together with a large tumor behind it removed by Dr Samuel Crowe. Histological examination showed mixed



Fig 338. Mixed tumor left upper eyelid of two years duration. Colored male four years of age.

tumor of salivary tissue The patient returned with difficulty in hearing in the left ear Nasopharyngoscopic examination by Dr Walter Loch showed a tumor involving the left lateral pharyngeal wall just in front of and below the eustachian orifice (Fig 339) On account of the scarring in the left tonsillar fossa from the previous operation and because of the patient's marked gag reflex, a good view of the tumor could not be obtained by a throat *mirror* An

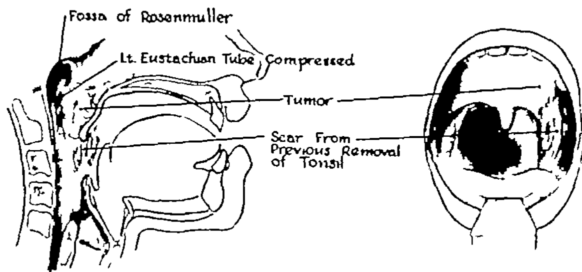


Fig. 339 Sarcoma, pharynx developing from mixed tumor left tonsillar fossa removed four years previously. Metastases found in preauricular nodes same side.



Fig 340

A Mixed tumor aberrant salivary tissue hard palate measuring 2 cm. in diameter partially ulcerated nodular

B Photomicrograph shows well-developed acini moderate amount of fibrous tissue stroma. Eight years later patient returned with metastases to the cervical lymph nodes. Radical neck dissection was done. Pathological examination confirmed clinical impression of metastases.

enlarged node also was present in the left parotid region.

At operation the node was removed and frozen section showed sarcoma. The primary tumor in the nasopharynx could be readily palpated with the patient anesthetized, and proved to involve practically the whole left side of the nasopharynx. It was approximately 2 x 3 or 3.5 cm. Aspiration biopsy revealed sarcoma. The pathological sections from the previous operation were reviewed and showed very similar areas of stroma which could have readily given rise to the recurrent sarcoma. The patient was then treated by radon implantation in the primary tumor and by x ray therapy to the nodes in the neck. It was felt that the disease had spread beyond operative removal. The case is too recent for comment on the final result.

TREATMENT

Aberrant salivary tissue tumors of the soft and hard palate require surgical excision.

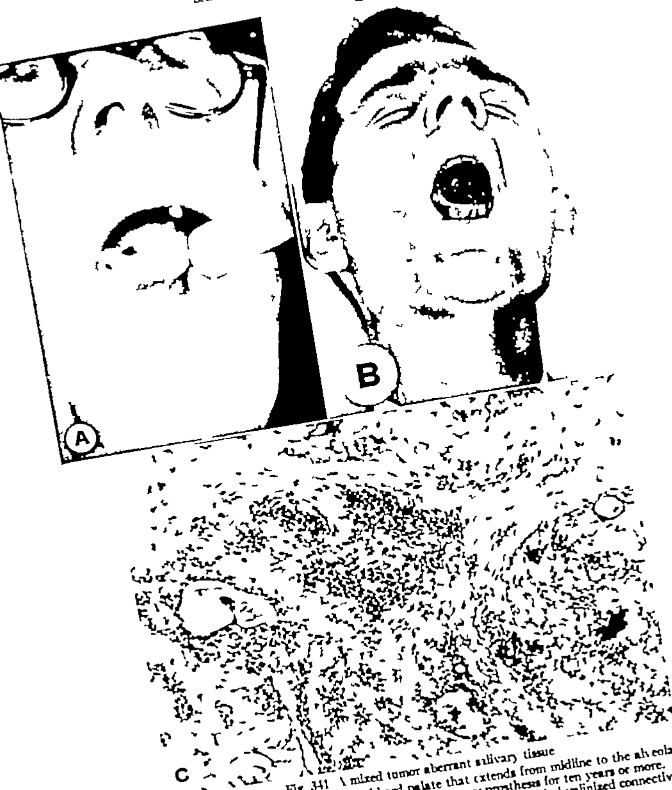


Fig. 341 A mixed tumor aberrant salivary tissue
A. Bulging tumor at the junction of soft and hard palate that extends from midline to the alveolar ridge
B Wound after removal of tumor Patient has worn satisfactory prosthesis for ten years or more.
C Photomicrograph shows strands and nests of epithelial cells interspersed in hyalinized connective tissue Few acini are present

Should the soft palate be invaded very deeply a perforation may result We have not had this experience Most of our cases have occurred farther forward at the junction of the soft and hard palate or on the hard palate itself Removal is either electrosurgical or by scalpel incision of the mucous membrane around and wide excision of the tumor (Fig 340 A and B) Several of these tumors have invaded the antrum. Electrosurgical resection of the upper

alveolus may open into the antrum, resulting in a large defect which may be closed by a prosthesis, permitting the patient to eat and talk and resume normal functional activities (Fig 341 A–C) Should it be impossible to remove all of the salivary tissue, adherent areas are thoroughly destroyed with electrocoagulation. The coagulated tissue sloughs away in a few weeks and small bits of sequestra are removed as indicated, aiding in the healing of the wound and keeping down infection

Temporary prostheses are made carrying obturators of soft acrylic or soft rubber These are worn until the edges of the wound are well healed, when a firmer permanent prosthesis is made It is an advantage to have an impression of the upper jaw made before operation On a stone cast of such an impression the approximate outlines of the operation are drawn The prosthodontist then plans the prosthesis to be made and fitted in after operation.

MANAGEMENT OF FACIAL NERVE INJURIES AND REPAIR

By Edward A. Kitlowski, M. D

Operative procedures in the area of the parotid occasionally result in trauma to the facial nerve. It may be injured so that there will be a passing facial paralysis or the nerve may have to be removed in order to obtain a cure When the nerve is only traumatized and there is a passing palsy care should be taken to protect the muscles to avoid over-stretching resulting in permanent disfigurement This is best done by inserting a hook in the corner of the mouth, fastened to a strap attached to a band around the forehead, so that the corner of the mouth is pulled up over-correcting the affected side This apparatus is worn by the patient at night It need not be worn continually inasmuch as the over-correction for the twelve hours will be sufficient to protect the muscles for the remaining twelve hours of the day The nerve should be stimulated daily with a galvanic current during this time to aid in keeping muscle tone. Muscles protected in this fashion will have such good tone that there will be no deformity in the face after the nerve regenerates.

When the nerve is removed paralysis will be permanent The extensive operation required to remove a malignant tumor together with the draining lymphatics and nodes, is so formidable that added plastic repair should be reserved for a later time In addition it is wise to delay reconstruction until there is reasonable assurance against recurrence The affected area should be supported as described for three to six months before correction is attempted. Correction of the disfigurement is important to the patient cosmetically and also by way of protecting the eye. Inasmuch as the lower lid drops away from the eye so that it cannot wash out dust by blinking particularly while the patient is asleep corneal ulcers may develop and cause the loss of the eye. During the waiting period, the patient wears a contact lens to protect the eye if desired.

Associate Professor of Surgery Chief of Plastic Surgery Medical School, University of Maryland

Operative Technic (Fig 342 A–D)

Fascia strips are taken from the thigh by means of a fascia stripper through two small incisions, each about 1 inch long one near the trochanter and one near the knee An incision is made in front of the ear exposing the temporal fascia One fascia strip is threaded onto a large needle, such as is used for sewing bags, or a Blair fascia needle, and forced through the cheek well beneath the skin so as not to show a band in the face and carried across the midline of the upper lip An incision is then made in the skin beyond the midline of the upper lip and the fascia pulled through The needle is then passed back through the incision at another area coming out through the temporal opening The loop of fascia has its attachment beyond the midline of the upper lip and both ends of the fascia are now sutured into the fascia of the temporal muscle tied

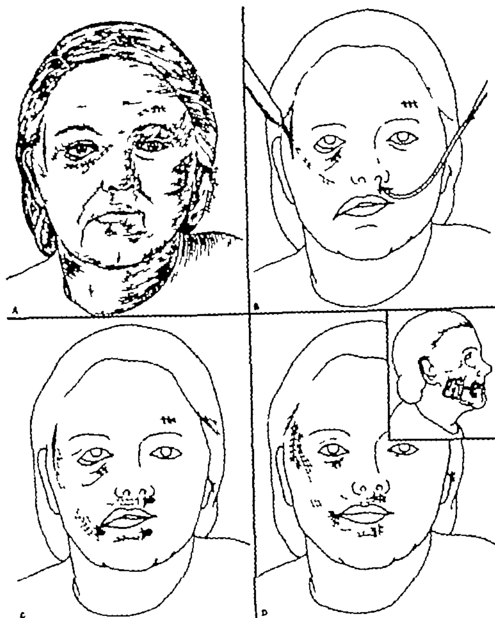


Fig. 342 Technic of repair of facial nerve injuries. (Blair Davis-Kitlowski)

A Incision from in front of helix parallel to concha to ½ inch in hairline exposing the temporal fascia. If there is marked redundancy of the skin due to old facial paralysis, the skin is undercut about 1.5 cm. on face up to zygoma. Incision is made in wrinkle line over left frontal region about ½ inch above eyebrow The second incision is made near the inner canthus of eye to facilitate the passage of the fascia. The fascia is threaded on a fascia needle which is passed subcutaneously beginning at the temporal incision and coming out of the incision near the inner canthus. The needle is then reinserted care being taken not to include the skin. The needle is passed subcutaneously over the root of the nose to emerge in the incision over the eyebrow The needle is then re-inserted in the incision deeply enough to include some of the frontalis muscle and passed subcutaneously through another channel to emerge from the incision at the inner canthus. The needle is then reinserted in this incision and passed subcutaneously to emerge in the incision in the temporal fascia. The two ends of the fascia are now caught with clamps. The incisions above the eye and canthus are closed with nylon sutures. The ends of the fascia are passed through the temporal fascia and tied in a knot secured with a suture through the knot, overcorrecting the eyelid All knots are tied at one time

B An incision is made beyond midline of the lip ½ inch long, midway from the floor of the nostril and the vermilion border of the lip The fascia needle is threaded with fascia and passed subcutaneously to the incision in the upper lip. The needle is passed back through the incision to the orbicularis muscle and through the other muscles to emerge at the incision in the temporal fascia The two ends are threaded on fascia needles and pulled through the temporal fascia with as much over-correction as possible The fascia is then tied and sutured to prevent the knot from slipping

C In like manner a loop of fascia is passed to the corner of the mouth and another one in the lower lip beyond the midline and tied securing over-correction. A loop of fascia can be passed from the corner of the mouth into the masseter muscle designed to give some expression to the corner of the mouth by utilizing the active masseter muscle If there is redundancy some of the skin around the temporal wound is removed The skin incisions are then closed with nylon sutures.

and the knot sutured with silk to prevent slipping A second piece of fascia is similarly carried through the corner of the mouth and a third one passed into the lower lip beyond the midline These three strips of fascia are tightened to produce marked over-correction An additional strip of fascia is also passed through the masseter muscle toward the corner of the mouth This will give some appearance of function around the mouth when the patient talks because of its attachment to the masseter which has its enervation intact The fascia for the upper lid is best introduced in the temple region passed through the lower lid, across two or three months as the fascia bands act as barriers for the free lymph drainage of the face. Such edema gradually clears up giving the patient a satisfactory appearance when at rest (Fig 343 A and B)

SIALOGRAPHY

Sialography is the roentgen visualization of the larger salivary glands (namely the parotid or submaxillary) after the injection of a radio-opaque substance into their respective ducts By this method the main duct and the duct tree and parenchyma of the gland can be studied aiding the differential diagnosis of dis-



Fig 343

A. Facial paralysis following radical excision for carcinoma of the parotid
B Correction of facial paralysis by fascial transplant, as indicated in Figure 342.

the side of the nose, over beyond the midline into the frontalis muscle of the opposite side It may then be fastened in this area or it may be passed through the forehead on the affected side, into the fascia again, coming out at the original incision This creates a large loop which may be tightened up lifting the lid toward the eye sufficiently to protect the eye Fresh fascia from the patient is more desirable than preserved fascia inasmuch as the latter tends to stretch and also to become fibrous bands. Fresh fascia remains fresh and permits the most assured fixation Subsequent to this operation there quite frequently will be a certain amount of edema lasting over a period of eases of these organs, in a way comparable to similar studies in other inaccessible organs. In recent years it has been our policy to study the parotid gland by sialography as often as possible when there is indication that such a study would be of benefit in the differential diagnosis of the condition at hand, or in planning treatment In an excellent article by Blady and Hocker the indications for sialography are laid down as follows

1 To demonstrate the relationship of the normal parotid duct and gland to other adjacent structures

2 To demonstrate salivary fistulas

3 To demonstrate the presence of calculi, foreign bodies or strictures of the parotid duct.

4 To demonstrate and confirm clinical diagnosis of chronic recurrent parotitis.

5 To investigate possible involvement of the gland and duct in a variety of pathological conditions affecting the cheek and parotid region

6 To determine whether the tumor in the parotid region is an encapsulated growth in the gland substance, a tumor infiltrating the duct system and gland or a mass extending to the gland and ducts proper

7 To determine the proximity of the retromandibular process of the gland to a mixed salivary tumor in the tonsillar region

8 To aid in the planning of an operative procedure in the parotid region

We have found sialography to be of assistance in determining the proximity of tumors in the cheek or the parotid region to the duct and the parotid gland and in differentiating tumors from chronic inflammatory reactions Our series has been too small for statistical study We have followed the criteria for differential diagnosis as laid down by Blady and Hocker and find it of great value in clinical work



Fig. 344 Sialogram right parotid gland. Complaint lump in right cheek. Practically normal sialogram. Final diagnosis organized angioma beneath buccal mucosa.

TECHNIC

The technic of sialography is rather simple. Occasionally there is some difficulty in identifying and catheterizing the orifice of Stensen's duct but in the majority of cases a small canula can be inserted and the duct system injected

Instruments. The following instruments should be available

1 A set of tear duct probes
2 A 2 cc. Luer syringe
3 One or two canulas of varying sizes to fit the tiny duct opening or a $1\frac{1}{2}$ or 2 inch 20 gauge hypodermic needle made blunt

A ureteral catheter canula suffices for canulization of large ducts

Any available non irritating radio-opaque injection material is satisfactory We have employed lipiodol most frequently

The patient should be in a sitting position. Lighting facilities should be adequate to illuminate the inside of the mouth In some cases where illumination can be obtained on the x ray table the patient may be placed on his back and injection made just before the films are taken. If it is deemed advisable to inject the duct while the patient is on the operating table we usually preliminarily probe the duct with the patient in a sitting position in order to determine its location and patency We do not use topical anesthesia



Fig 345 Sialogram left parotid gland Note the rather thick puddling of the lipiodol in the ducts. The normal fine fibrillar branching is not present Diagnosis chronic parotitis.

The orifice of Stensen's duct located in a papilla on the buccal mucous membrane opposite the upper second molar tooth will discharge saliva on slight pressure along the cheek identifying an otherwise almost invisible opening A narrow orifice may require dilatation is necessary to avoid injury to the mouth of the duct causing scarring and constriction and later obstruction of Stensen's duct. Should any bleeding occur or should there be any difficulty in catheterizing the duct, with resultant edema the procedure should be discontinued

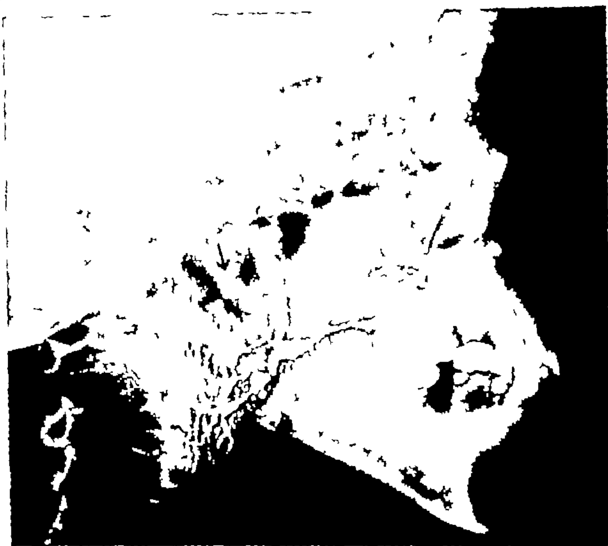


Fig. 346 Sialogram right parotid gland Complaint firm tumor in front of right ear Note dilatation of Stensen's duct with partial obstruction in midportion not associated with tumor Arrow indicates where the parotid tree has been thinned out by pressure of overlying benign tumor Some lipiodol spilled out into the mouth. Diagnosis benign mixed tumor parotid gland.

with probes to permit the ready access of the injection canula Two to two and one-half centimeters of opaque solution usually suffice to distend the duct and the parotid tree As the duct system gradually fills the patient complains of pain in front of the ear The injection should be continued if the pain is not too great beyond the first sensations in order to secure adequate distention of all the ducts. The injection is made gently and slowly Great care and repeated attempts made several days later after the edema has subsided

Lateral stereoscopic and either single or stereoscopic anteroposterior films are obtained It is well to have the head hyper-extended to give better visualization of the retromandibular lobe of the *parotid gland*

The after care of the patient is simple He is instructed to eat normally and chew gum for several hours to facilitate the flow of saliva to

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Fig 346. Sialogram, right parotid gland. Complaint firm tumor in front of right ear Note dilatation of Stensen's duct with partial obstruction in midportion not associated with tumor Arrow indicates where the parotid tree has been thinned out by pressure of overlying benign tumor Some lipiodol spilled out into the mouth Diagnosis benign mixed tumor parotid gland.

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The orifice of Stensen's duct located in a papilla on the buccal mucous membrane opposite the upper second molar tooth will discharge saliva on slight pressure along the cheek, identifying an otherwise almost invisible opening. A narrow orifice may require dilatation is necessary to avoid injury to the mouth of the duct causing scarring and constriction and later obstruction of Stensen's duct. Should any bleeding occur or should there be any difficulty in catheterizing the duct, with resultant edema the procedure should be discontinued



Fig 346. Sialogram, right parotid gland. Complaint firm tumor in front of right ear. Note dilatation of Stensen's duct with partial obstruction in midportion not associated with tumor. Arrow indicates where the parotid tree has been thinned out by pressure of overlying benign tumor. Some lipiodol spilled out into the mouth. Diagnosis benign mixed tumor parotid gland.

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The after care of the patient is simple. He is instructed to eat normally and chew gum for several hours to facilitate the flow of saliva to

wash out the opaque substance in the duct system Gentle massage of the parotid region may be indicated. We have had no complications following this technic Some observers have reported infections but fortunately this has not been our experience.

After a careful study of the amount of lipiodol necessary to completely fill the duct system Blady and Hocker "arrived at an arbitrary rule requiring a total injection of three to five times as much lipiodol as the initial amount producing discomfort and pain. This pain continues until two or two and a half cubic centimeters are injected and then all pain disappears apparently due to diffusion of the lipiodol into gland parenchyma. Usually after one half cubic centimeter of lipiodol has been injected palpable enlargement of the gland is noted Palpable enlargement of the gland has occurred in most of our cases that have been injected with a sufficient amount of lipiodol to produce a good roentgenogram Over-distention of the duct system causes a diffusion of the oil throughout the organ obscuring the definition of the secondary ducts and their finer ramifications One should guard against injecting too much fluid into the duct system

Normal appearing sialograms show a duct running almost horizontally backward perhaps slightly downward from the opening in the buccal mucous membrane Sometimes there is a slight curve upward in the cheek (Fig 344) The main duct then divides and subdivides, producing a tree-like appearance In the A P view it is possible to outline the retromandibular lobe of the parotid and to determine how close to the pharyngeal wall it lies. This is important for not uncommonly salivary tumors are found in the pharyngeal wall lateral to the tonsils Also sometimes large tumors



Fig. 347 Sialogram right parotid gland. Complaint painless lump in right cheek. Note in sialogram displacement of Stensen's duct, upward around the lump. Final diagnosis lymphoma, cheek lymphatic leukemia 4 years later

extend from just beneath the skin back of the mandible and push the pharyngeal wall medially

Chronic parotitis. In cases of chronic parotitis, there is sacculation or puddling of the duct, giving a snowflake like appearance (Fig 345)

Benign tumor Benign tumors of the parotid are circumscribed and therefore any filling defect in the duct tree will be regular due to displacement of the ducts surrounding the tumor Each duct is visualized throughout its entirety and the configuration of the defect varies with the size of the tumor (Fig 346) The main duct may be displaced or there may be considerable displacement of various ducts in the gland depending upon the location of the tumor (Fig 347)

Carcinoma. Since carcinoma and other malignant tumors are invasive, the various ducts are destroyed in an irregular fashion Failure to visualize the parotid duct system in its entirety is then present There may be abrupt stoppage of the main duct and there may be irregular filling defects in the duct system. Also there will be localized diffusion or puddling of the opaque solution due to erosion of ducts and their distortion by the malignant process

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Chapter XII

TUMORS OF THE TONSILS, PHARYNX, AND BASE OF TONGUE

This chapter deals with benign and malignant tumors of the nasopharynx, oropharynx, tonsils, hypopharynx and base of the tongue. Reference is made to Chapter II on embryology for a discussion of the development of the epithelium of the pharynx and its various subdivisions. Because of the similarity of epithelium throughout the pharynx and over the tonsils, tumors in these regions are grouped in this chapter. Aberrant salivary tissue tumors occur in the pharynx and tonsils occasionally; these are discussed in Chapter XI.

TUMORS OF THE TONSILS

Ewing (1928) states that 10 per cent of all buccal cancer is in the tonsil. Cancer of the tonsil is sufficiently frequent to warrant a careful investigation of the throat in every patient complaining of persistent sore throat or a lump in the neck.

Anatomy of the Tonsils

The tonsils are two masses of lymphoid tissue placed one on each side of the oropharynx between the pillars of the fauces and vary greatly in size at different ages and in different individuals. The presence of lymphoid tissue covered with epithelium makes possible the development of a variety of tumors. The blood supply of the tonsils is mainly from the ascending pharyngeal and facial arteries; twigs from the lingual and descending palatine arteries reach the tonsil beneath the mucous membrane. There is a venous plexus communicating with the veins of the pharynx. The internal carotid artery ordinarily lies "well posterior to the tonsil and is separated from it by the stylopharyngeus muscle. Moreover there is an interval of 1.5 cm. or more separating the tonsil from these structures. The external carotid artery lies about 2 cm. from the lateral pharyngeal wall and is separated from it by a portion of the parotid gland and the musculature about the styloid process." (Callander 1933.) In spite of the distance of 1.5 to 2 cm. between the tonsil and the internal and external carotid arteries, respectively, occasionally an extensive malignant growth or extensive slough following irradiation, produces lethal hemorrhage by rupture of one of these large vessels.

The lymphatic drainage of the tonsil is abundant. The lymphatic vessels penetrate the wall of the pharynx to enter the deep cervical nodes slightly below the angle of the jaw. The superior deep cervical node which lies along the jugular vein in this region is sometimes called the tonsillar lymph node; at other times it is called the chief node of the neck because it receives drainage from so many structures in and about the head and neck.

MALIGNANT TUMORS OF THE TONSILS

Incidence

As stated above, Ewing reports that 10 per cent of all buccal cancers occur in the tonsils. Most of the cases occur in the 5th and 6th decades of life although Martin and Sugarbaker (1941) report that their youngest case was in a child eleven years of age. The disease is much more common in men than in women.

Etiology

There is no known etiology of cancer of the tonsil. Its embryological development is not sufficiently characteristic to suggest an origin of tumors of the tonsil from embryological malformations. The usual contributing causes to the development of cancer in the oral cavity anterior to the pillars such as poor oral hy

giene rough teeth and malfitting dentures, would hardly have any influence upon the tonsil Martin and Sugarbaker report that about 70 per cent of their patients use tobacco about the percentage of addiction found in the normal male adult population of a corresponding age

Histology

Tumors of the tonsils may arise from ectodermal or mesodermal tissue. The ectodermal tumors are of the squamous cell or transitional cell types In our experience well-differentiated squamous cell carcinomas of the tonsil are not common Carcinoma of the tonsil is usually of the less differentiated types of grade II or III or transitional cell variety which respond to radiation Epidermoid carcinomas in the tonsil are similar histologically to those in the surrounding nasopharynx Frequently the tonsil and pillars of the fauces and adjacent portion of the tongue are so extensively involved when the patient is first seen that it is difficult to determine the primary site

The mesodermal tumors are usually lymphosarcoma Lympho-epithelioma occasionally occurs in the tonsil and its clinical history is similar to that of lympho-epithelioma in the neighboring tissue (see Chapter XVIII) Walker and Schulz (1947) report one case of Kaposi sarcoma in a series of ninety cases of malignant tumors arising in the tonsil.

Clinical Behavior

The early symptoms of malignant disease in the tonsil are slight or persistent sore throat a history of repeated tonsillar abscess or the appearance of an enlarged lymph node in the neck It is surprising how many patients (particularly those seen in the dispensary who are not too observing) give a history of sore throat for only a few weeks or occasionally a few days, but on examination a very extensive growth involving tonsil pillars and adjacent tongue is found as well as an enlarged lymph node This unfortunate circumstance may be explained by the fact that the tonsil is in a position where motions of the jaw cause little discomfort and the only time a subjective symptom is noticed would be during swallowing Malignant tumors in the oral cavity are notably painless until late so that it is possible for a malignant ulceration to be present in the tonsil without giving symptoms particularly to the unobserving patient until an advanced stage is reached The first symptom in many patients is the appearance of a hard lymph node just lateral and slightly beneath the angle of the jaw metastases to the chief node of the tonsil and since it is noted without pain patients often wait until the node attains considerable size before seeking medical advice. Rarely is bleeding an early symptom.

The primary lesion of epithelial malignancy of the tonsil is most frequently an ulcer occurring on the tonsil itself anterior or posterior pillar or at the junction of the anterior pillar with the base of the tongue (Fig 348) As the disease progresses, the ulcer extends over the *adjoining mucous surfaces of the lateral* pharyngeal wall one or both pillars the adjacent portion of the tongue and sometimes onto the gingiva back of the last molar tooth, and buccal surface Some cancers of the tonsil are papillary growing out into the oral cavity and oropharynx (Fig 349) Others infiltrate deeply into the submucous structures and muscles Occasionally carcinoma of the tonsil develops beneath the mucous membrane as a hard tumor without ulceration. More commonly nonulcerated tumors of the tonsil are lympho-epithelioma, sarcoma, or lymphosarcoma

METASTASES

Metastasis to the cervical lymph nodes is early and often rapid and extensive because of the elaborate network of lymphatic channels draining the tonsils (Fig 350) misleading the patient and, at times the physician to the erroneous diagnosis of tonsillitis and sore throat Most commonly the first node to be involved is the deep superior cervical node or chief tonsillar node with rapid extension down the jugular chain Metastases from the tonsil and adjacent structures are usually further back and higher in the neck than metastases from the mouth anterior to the pillars Metas-

tases are frequently present on admission in cases of lympho-epithelioma, transitional cell carcinoma and lymphosarcoma

Diagnosis

As with malignant disease elsewhere, final diagnosis is made by biopsy A tentative diagnosis is evident when there is a persistent ulcer of several weeks duration in a patient, particularly a male past middle life One should not wait until lymph node enlargement occurs before suspecting cancer In our experience, we have not seen syphilis associated with cancer of the tonsil in a higher percentage than syphilis present in the normal population Occasionally tuberculosis occurs on the palate or pillars. Tuberculous ulcers are painful, superficial and have a clean nodular base Tuberculosis of the tonsil is secondary to pulmonary tuberculosis A roentgenograph of the chest is part of the routine examination of all patients having a chronic ulcer in the tonsillar region to determine the presence or absence of tuberculosis and metastases

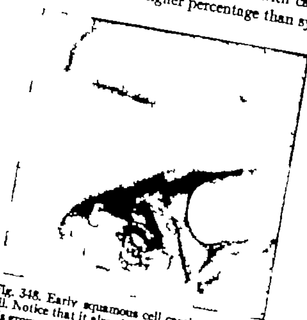


Fig. 348. Early squamous cell carcinoma of the left tonsil. Notice that it already involves the anterior pillar and is growing onto the tongue a frequent complication with these tumors

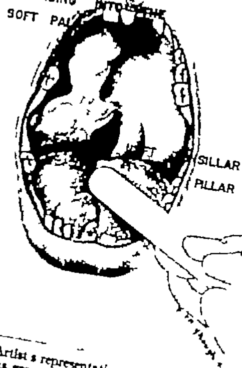


Fig. 349 Artist s representation of carcinoma of the tonsil that has grown upward onto the soft and hard palate. This drawing was made from a white male patient, aged 47 Onset 10 months ago First symptom, pain in the tonsil the tonsil diagnosed elsewhere as abscess of tonsil the tonsil was lanced and treated with silver nitrate Patient continued to be treated for tonsillar infection, trench mouth and syphilis although his STS was negative Biopsy showed squamous cell carcinoma. On admission to the clinic, metastases were present

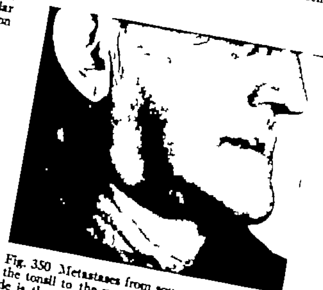


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Treatment

Until the advent of radiation therapy both radium and x ray the surgical treatment of carcinoma of the tonsil was limited largely to

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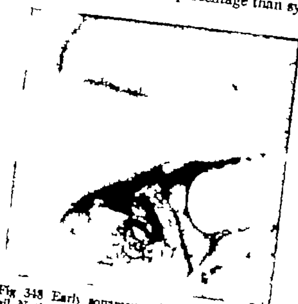


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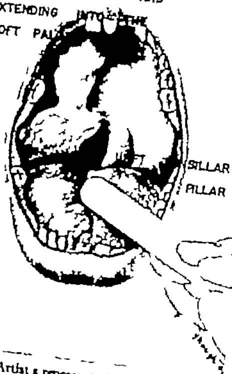


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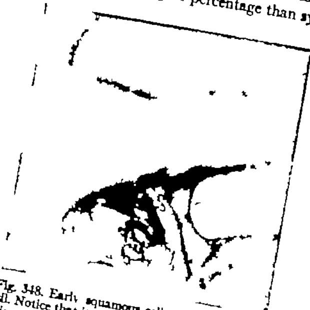


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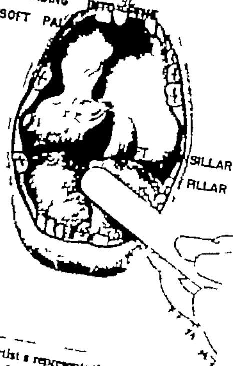


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the removal of the tonsil in very early cases. Occasionally lymphosarcoma lympho-epithelioma or a deep-seated non ulcerated cancer is found upon routine removal of enlarged tonsils Naturally these cases give the best prognosis because the lesions are early

RADIATION THERAPY

Radiation therapy of malignant tumors of the tonsil must be individualized. Although no *hard and fast rules* can be *laid down* certain general principles are followed, chief of which is to deliver to the area of growth and a surrounding zone of at *least* a centimeter 8000 r units, if possible. Treatment is by external and intraoral x ray therapy, supplemented by *implantation of radon seeds if indicated. For the* more sensitive lympho-epithelioma lymphosarcoma and transitional cell carcinoma a lesser amount may be used. In treating extensive cancer of the tonsil with large fixed nodes, the dosage is reduced. Since the outlook is bad, it is unwise to put the patient through the discomfort associated with intensive irradiation without reasonable hope of cure. When a radium bomb is available, teleradium therapy as advocated by Berven (1937) and others, is efficacious.

Radiation technic for carcinoma of the tonsil. A great many of these patients have severe trismus, and it is not always possible to treat intraorally Whenever the mouth can be opened sufficiently to permit we treat the patient first with an intraoral cone using the following factors 140 Kv 35 cm. TSD no filtration, 15 Ma. Treatments are given three times weekly the daily dose being 680 roentgens, attempting to deliver a total of 7000 roentgens measured in air Upon completion of this intraoral series, the patient is then treated through an external port, the center of which is placed over the area of projection of the tonsillar fossa The factors are 200 Kv 50 cm TSD 15 Ma. and $\frac{1}{2}$ mm. Cu + 1 mm. Al.

Three hundred roentgens are given per treatment three times a week for a total of 2400 roentgens measured in air

Radon seeds are implanted into the tonsillar fossa, if necessary to carry the dose to the desired amount, especially if treatment through an intraoral cone is only partially adequate or could not be employed at all. (See Chapt. I for radon dosage calculation)

Tumor doses with this technic are in the neighborhood of 8000 roentgens to the center of the lesion.

Complications of radiation therapy In the average small and medium sized tumor slough, secondary to irradiation with teleradium or external x ray coupled with an intraoral x ray cone, is usually not severe. A well marked epithelitis reaches its peak of severity at the end of the second or in the third week, associated *with epithelitis of the skin which heals in three* or four weeks. When radon implantations are added to the x ray therapy there is a severe sore throat and slough often interfering with proper nourishment The patients may require feeding through a retained intranasal tube or they may be taught to pass an intranasal catheter A diet of about 3000 calories per day, containing an adequate supply of vitamins and minerals, serves to keep the patient in fairly good nutrition As the slough comes away secondary hemorrhage may occur and, if severe, may require ligation of the external or internal carotid artery In the exceptional case, radio-osteonecrosis of the mandible may develop This complication requires removal of the necrotic bone.

Radiation treatment of metastases. Single, hard nodes outside the scope of the external x ray beam directed towards the primary lesion are treated separately through a suitable sized cone or preferably by the implantation of radon seeds When the primary lesion is eradicated with radiation, the less advanced cervical metastases should be treated with radical neck dissection (see Chapt XIX for composite operation) Large metastatic nodes present on admission are first treated by x ray therapy in a manner similar to that just outlined, using a suitable sized portal This x ray therapy is then followed by the implantation of radon seeds. *As stated in Chapter I we use Quimby s table*

for calculating the doses to be given in the tumor masses and usually aim to give a tumor dose of between 8000 and 10 000 r within the growth

SURGICAL TREATMENT OF CARCINOMA OF THE TONSIL

As already mentioned surgery of the primary tonsillar growth has a very limited field In recent years, we have attempted to enlarge the scope of surgery in selected cases The prognosis of the treatment of carcinoma of the tonsil by any means is not good therefore, any reasonable attempts to improve the results are warranted. Then too it has been our feeling that if some of the complications already mentioned can be avoided by operative removal of the radiated tissue, the convalescence will be hastened and less painful In Chapter XIX, dealing with metastatic neck tumors, the composite operation is described. A detailed description of the operative technic is not given here.

The rationale of this operation is first, to remove any lingering growth that may be left after thorough irradiation and second, to remove the lymphatic draining area of the neck Just how valuable this operation will be in controlling carcinoma of the tonsil remains for further experience to determine. We have employed it in a few selected cases (See Table 45) The patients are carefully screened as to physical ability to undergo the operation and the extent of the disease on admission. Small tumors with or without minimal metastases would seem to be most suitable for the composite operation Other tumors which were very extensive when first examined may reduce considerably in size under x ray therapy and apparently become operable However before deciding in favor of a composite operation, careful examination is necessary to determine any submucous extension which might not be surgically removable The following case history illustrates some of the problems better than a long discourse

The patient a white female aged sixty was referred by L. P Henneberger dentist on March 18, 1947 because of a large growth in the mouth which had been present for over a year Trismus limited separation of the incisor teeth to about 1 or 1.5 cm A large coxcomb growth could be seen apparently springing from the right side of the floor of the mouth. As well as could be determined the growth extended back into the tonsil and pterygoid muscles producing the trismus. There was one enlarged submaxillary lymph node. Biopsy was taken in the office and several others in the hospital before operation All showed inflammatory tissue. On March 26, 1947 the patient was anesthetized with a basal anesthesia of sodium pentothal administered intravenously supplemented by nitrous-oxide and oxygen through an intranasal tube. Through a submaxillary incision in the neck, the palpable node was removed and a frozen section made. The pathological diagnosis was squamous cell carcinoma. A composite operation was carried out, the only variation from the usual procedure being that the neck dissection did not extend down to the clavicle, as there were no palpable nodes in the lower neck. At operation, the growth was found to involve the floor of the mouth, part of the base of the tongue, tonsillar fossa, and extended into the pterygoid muscles. It was densely attached to the jaw and formed a rather large mass in the submaxillary triangle. The submaxillary triangle was dissected clean the jaw removed from the canine region back to the condyloid neck. The temporomandibular joint was not disturbed. Removing the jaw allowed easy access to the pterygoid fossa and removal of the growth together with the anterior pillars, right half of the palate, tonsillar region, base of the tongue, and floor of the mouth. On April 3 1947 1200 mg hr of radium were given by inserting a radium plaque through the mouth into the pterygoid fossa. Calculated at a centimeter distance, this gave approximately 7000 gamma roentgens to the walls of the cavity The wound healed per primum, postoperatively Beginning on May 5, 1947 and continuing through May 21 2400 roentgens measured in air were given through the cheek using the following factors 200 kv., 15 Ma., ½ mm. Cu., 1 mm Al. filter- size of port 6 x 8 cm. TSD 50 cm Figure 351 shows the patient after complete healing She is free of disease at present (3 years)

It has been our practice to give these cases preoperative radiation in order to reduce the size of the growth and surround it by dense scar tissue On several occasions, the skin wound has broken down because of poor circulation particularly evident in very thin individuals with little subcutaneous fat We feel that when the composite operation is planned at the outset of the course of treatment, the radiation of the tonsillar area should be limited to an intraoral cone and the use of radium or

radon seeds intraorally omitting external radiation so that there will be little damage to the skin As is described in Chapter XIX previous preparation of the skin by grafting procedures often prevents secondary breaking down and allows for earlier healing

Prognosis

The outlook of carcinoma of the tonsil is not good but it is better now than in previous years. Duffy (1932) states Of the 122 cases in this series, only 51 or 41.8 per cent were admitted without cervical metastases Only



Fig. 351 Photograph of patient after composite operation consisting of dissection of the upper half of the neck, resection of the jaw floor of the mouth, half the tongue tonsil, palate and pterygoid fossa, followed by radium in the pterygoid fossa and x ray therapy externally (see text and Chapt. XIX for details) Patient well 3 years following operation.

those patients treated up to 1925 can be included in the five year group Of these forty nine cases thirteen had no cervical nodes throughout and five or 38 4 per cent are well thirteen developed metastases after admission and none is well fifteen had operable nodes on admission and four or 26 6 per cent are well eight had inoperable nodes on admission and one, or 12.5 per cent is well. In the group treated five or more years ago ten patients are now clinically free of disease from five to nine years, a percentage of 20 4 " Martin and Sugarbaker (1941) state that the prognosis in cancer of the tonsil is better in transitional cell carcinoma and lymphosarcoma than in squamous carcinomas We agree with their further statement that lympho-epithelioma which is the most radiosensitive of the group gives the poorest prognosis. The net five year cure rate in their series of 148 determined cases was 18 per cent Berven (1937) reports on 457 oral cavity cancers, chiefly treated by local application of radium and teleradium He has devised an ingenious system of cross-firing from many different portals, so that by a combination of intraoral and external irradiation, carcinomas of the tonsils receive 4050 r in the tumor With such technic he is able to obtain in thirty nine cases of carcinoma and lympho-epithelioma of the tonsil sixteen or 41 per cent, living five years or more Of forty nine cases of sarcoma of the tonsil treated, seventeen or 35 per cent lived free of symptoms five years or more

Walker and Schulz (1947) give the following results of treatment of ninety cases of carcinoma of the tonsil using intra and extraoral irradiation therapy No neck dissections were carried out. Twenty five per cent of the cases without metastases and 9 per cent with metastases survived five years. There was no striking advantage from the use of supplemented radium Supervoltage irradiation produced significant increase in percentage of five year survival, as compared with high voltage therapy As a whole patients with recurrence within the first six to twelve months after irradiation were not benefited by further irradiation When the recurrence did not appear until more than one year after initial treatment supplemental therapy appeared to be of definite value.

Salivary Tissue Tumors

These tumors are adequately described in Chapter XI dealing with salivary gland tumors and will not be dealt with here

Sarcoma

Sarcoma of the tonsils is rare Its etiology is unknown The chronic irritations, as syphilis,

tobacco, and oral infection, are not etiological or contributory factors Sarcoma of the tonsils does not ulcerate early unless incised by the attending physician Examination reveals a large normal appearing tonsil with an intense redness of the fauces and soft palate. Enlarged cervical lymph nodes at the angle of the jaw may be the first symptom

Patients with sarcoma of the tonsils frequently are treated for trench mouth, syphilis, abscess or infection, during which time metastases to the cervical lymph nodes occur Adequate tissue for histological examination from the tonsil or cervical node is necessary for diagnosis

Treatment of sarcoma of the tonsils or metastases to the cervical nodes is with irradiation Whitcomb (1943) has shown the prognosis to be poor due to distant metastases.

Malignant Melanoma

Malignant melanoma of the tonsils is rare. We have observed no cases Howorth of London (1943) reported one case beginning as a diffuse pigmentation of fauces and palate without ulceration or mass at onset. Two years six months later a raised lobulated plaque appeared in the right tonsil. Irradiation was given because of small mass, but without effect. The tumor was excised with electrosurgery A small recurrence developed one year later which was again removed with electrosurgery There was no recurrence after one year

BENIGN TUMORS

New and Childrey (1931) found sixty three benign tumors of the tonsils during a study of 357 cases having tumors of the tonsils and pharynx. Forty two were in males and twenty one in females. The ages varied from seven to seventy three years Fifty five and five tenths per cent (35) were papillomas. Other types were cystadenoma (5) lipoma (4) fibroma (2) fibromyxoma (1) varices (2) hemangioma (2) lymphangioma (1) chondroma (1) osteoma (1) myxomatous polyp (1) retention cyst (3), and lymphoid tissue (5) Only 55.2 per cent of the patients knew that a tumor was present in the tonsil.

In our private practice we have seen two patients with a lymphoid tissue polyp in the tonsil One, a white woman in middle life was operated upon with Julian J Chisolm. The tumor had the surface dimensions of a normal tonsil but was about twice as thick and attached by a small pedicle. There has been no known recurrence after surgical removal.

Hanckel (1943) reported a case having a vascular fibrous polyp attached to the superior pole of the right tonsil. He found a 13 per cent incidence of tumors of the tonsil in 2200 tonsillectomies between September 1 1933 and September 1 1934 at the Massachusetts Eye and Ear Infirmary None of these thirty tumors was a true polyp

Plasmocytoma (Plasma Cell Tumor)

Boyd (1947) states that 'plasmocytoma is very rare but of importance in that it is benign and apt to be mistaken for lymphosarcoma It is composed of plasma cells." (See also "Malignant Tumors of the Nasopharynx.")

McNamara and Rogers (1943) reported one case having origin in the right tonsil and developing extensive cervical metastases which were highly radiosensitive. The clinical course was prolonged.

Willis (1948) states that "primary plasma cell tumors of soft tissue are almost restricted to the mucous membranes and submucous tissues of the alimentary and respiratory passages of the head and neck, the most frequent sites being the nasal cavity and nasopharynx." He quotes Kaufmann who refers to [illegible] occurring in the buccal cavity [illegible] larynx, and conjunctiva Although 'relat[illegible] and slowly growing they may erode adjacent bone. The primary neoplasm [illegible] single or multiple polypoid or lobulated [illegible]" and "secondary deposits have been [illegible] in the cervical lymph nodes or elsewhere. [illegible] further states that these tumors are [illegible]able to local removal or radiation ther[illegible]

MALIGNANT TUMORS OF THE NASOPHARYNX

By Mortimer Lee Williams, M.D.

Anatomy The nasopharynx is a dome-shaped vault joining the oropharynx and nasal cavities It begins at the junction of the right and left nasal cavities where the septum ends (posterior choanae) and curves gradually downward to end at the level of the soft palate. Except for the floor which is formed by the upper surface of the soft palate it is a very rigid structure and remains open at all times. The roof of the nasopharynx is formed by the inferior surface of the body of the sphenoid bone containing the sphenoid sinus The anterior wall is occupied by the two nasal choanae with the nasal septum between A growth arising in the posterior portion of the nasal cavity may extend backward through the choana and thereby give rise to a mistaken diagnosis of primary nasopharyngeal tumor The posterior wall of the nasopharynx is nearly vertical and is formed by the sphenoid bone and basilar process of the occipital bone

On the lateral walls are found the eustachian tube orifices, each bounded posteriorly by a prominent cartilaginous ridge the torus tubarius On each side and just posterior to these orifices is a vertical cleft known as the pharyngeal recess or fossa of Rosenmüller which extends laterally under the petrous bones almost to the carotid canals and the space between the two represents the widest portion of the entire pharynx The upper portion of each fossa lies directly beneath the foramen lacerum, a fact which is of particular significance as nasopharyngeal malignancies so often invade the fossa of Rosenmüller and from there pass through the foramen lacerum to the intracranial cavity Also from this fossa a growth whether malignant or benign, can cause compression of the eustachian tube orifice

Occupying a variable portion of the roof and posterior wall of the nasopharynx during childhood and sometimes during adult life, is lymphoid tissue, collectively known as the adenoid or pharyngeal tonsil In the midline just posterior to the main body of adenoid tissue, a small inconstant blind sac called the pharyngeal bursa is occasionally found. This supposedly represents an invagination of epithelium along the course of the degenerating tip of the notochord and is said to be constantly present in the child but only occasionally found in the adult. Between the posterior nasal septum and the adenoid tonsil is a structure of occasional significance. This is the so-called *pharyngeal hypophysis* derived from the lower end of Rathke s pouch and thought by some observers to be constantly present and to give rise to tumor As the cerebral hypophysis develops, the connection of Rathke s pouch with the oral epithelium elongated into a stalk which according to Arey (1942) vanishes when the embryo is two months old. Sometimes this may persist as a craniopharyngeal canal. According to Godtfredsen (1944) cell elements may become separated from this duct and later form craniopharyngiomas (hypophyseal duct tumors, Erdheim s or Rathke s pouch tumors, interpeduncular or suprasellar cysts) A more complete discussion of the embryology is presented in Chapter II

Blood Supply The two external carotid arteries supply the nasopharynx through four major branches from each Of these the internal maxillary arteries serve as the principal source, while the external maxillary ascending pharyngeal, and lingual branches make up the rest All anastomose freely with each other The internal maxillary artery is the larger of the two terminal divisions of the external carotid. It arises posterior to the neck of the mandible about the level of the ear lobule and courses anteriorly between the mandible and sphenomandibular ligament where its mandibular and pterygoid branches arise The third portion of this artery the pterygopalatine artery enters

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the pterygopalatine fossa and divides into its terminal branches, all of which pass through bony canals

Most of the venous drainage of the nasopharynx passes through the pterygoid and pharyngeal plexi The pterygoid plexus of veins empties into the posterior facial vein through a short common trunk, the internal maxillary vein, and into the anterior facial vein through the deep facial. The pharyngeal venous plexus lies between the constrictor muscles and the buccopharyngeal fascia It drains the deep muscles of the pharynx, the auditory tubes, and the palate and also receives branches from the Vidian vein of the pterygoid canal. It empties into either the internal jugular vein directly or the common facial vein through the pharyngeal vessels. The palatine vein accompanies the ascending palatine artery and drains into the anterior facial vein whose course corresponds to that of the external maxillary artery

INCIDENCE

Malignant tumors of the nasopharynx, although more commonly diagnosed now than formerly, are still relatively rare however when the field of study is narrowed down to include only those primary malignancies involving the head and neck, a rather prominent role is assumed by these tumors Martin and Blady (1940) report from the Head and Neck Clinic of the Memorial Hospital in New York an incidence of 2 per cent for nasopharyngeal malignancy of all malignant growths seen at that clinic For the sake of comparison, it is noted that this same clinic reports the incidence of cancer of the palatine tonsil as 3 per cent and of the tongue as 7 per cent. In India Rao (1944) has found the incidence of nasopharyngeal malignancies to be about 9 per cent of all malignancies of the nose, pharynx, and larynx. Reports from some sections of China rate it as high as 5 per cent of all cancer (Dunlap 1938) Godtfredsen (1944) estimated a yearly incidence of one case in every 181 250 persons in the Scandinavian countries. Application of this ratio to the population of the United States would give a yearly increase of 828 new cases.

AGE

Malignancy of the nasopharynx may develop in any age group Cases in children as young as four years have been reported The highest incidence, however is found between the ages of forty-one and sixty Godtfredsen, in his analysis of forty five cases, reported 52 9 per cent within this age group. When compared with cancer in other regions of the upper respiratory or alimentary tracts, these tumors show a much earlier age incidence. In most series of cases, the mean age for nasopharyngeal malignancy has been reported anywhere from 38.3 years (Thompson and Grimes, 1944) to forty nine years (Godtfredsen) and the large percentage of these seems to favor the mean age of forty three to forty five years (Zuppinger 1931 Van Metre Jr, 1948 Schinz and Zuppinger 1937, Martin and Blady, 1940) whereas the mean age for malignancy of the adjacent structures (tongue, lip, cheek tonsil, and larynx) is usually given as fifty-six to fifty-eight years. The fact that about one fifth of nasopharyngeal malignancies are found in patients under thirty years of age, readily coincides with this low mean age value. In the first three decades of life, the incidence of sarcoma is much higher than that of carcinoma, as the latter is usually found in the patients over thirty five years of age. It is of interest however, that a case of squamous cell carcinoma with bilateral cervical metastases has been reported in a boy eleven years old (Figi, 1941)

SEX

Like other malignancies of the upper respiratory and alimentary tracts, cancer of the nasopharynx presents a consistent predominance in males The male-female ratio in most series is 2 1 or 3 1 with approximately the same proportion in all age groups. So far no satisfactory explanation for this inequality has been offered. It is of interest to note that Godtfredsen in his series reports a reversal of this sexual ratio 2 1 for squamous cell carcinomas of the epidermal type.

RACE

Malignancy of the nasopharynx apparently does have a racial incidence The strikingly high susceptibility of the Chinese to this disease has been recognized for a number of years. According to Digby (1934) nasopharyngeal malignancies in Hongkong and South China ranked second in frequency on a list of all cases of malignant disease. Environmental factors such as the soot laden atmosphere in the small, poorly ventilated Chinese dwellings, have been blamed for this high incidence, but reports from nearby India, where much the same conditions exist, give about the same incidence as found among the Caucasians. Also Martin and Blady reported a large incidence among the Chinese living in New York City most of whom were born in China but came to this country at an early age. Such reports certainly favor a racial tendency in preference to environmental influences.

Concerning the proportionate incidence among the black and white races, little can be found. It may be of some interest to note that in Van Metre's series of forty-six cases 28 per cent were negroes and in a series of fifteen cases computed by Thompson and Grimes, this proportion was 27 per cent, however no further mention of any such consistent proportion has been found.

ETIOLOGY

So far no impressive reports have been made regarding any role that chronic irritation might play in nasopharyngeal malignancy Syphilis, chronic infection, the use of tobacco and dental defects, all of which seem to play a part in oral cancer apparently have no influence in this locality To our knowledge, leukoplakia which is generally considered a precancerous lesion has not been reported in the nasopharynx. No relationship to any abnormalities in the lymphoid tissue of Waldeyer's ring has been demonstrated

HISTOLOGY

The mucous membrane of the nasopharynx directly overlies a web-like fibro-elastic layer (tela submucosa) which in the fornix is fused with the periosteum of the skull however a loose submucosal layer is well developed over the lateral walls. Elsewhere the tela submucosa overlies and fuses with the interstitial tissue of the striated muscle layer sending strands of elastic fibers down between the muscular bundles. Wherever the tela or muscularis is not directly attached to periosteum the nasopharynx is invested by an outer coat of areolar connective tissue by which it is loosely united to adjacent structures. The nasopharyngeal mucous membrane for the most part approaches the structure of that of the respiratory system Stratified squamous epithelium is found overlying the soft palate, but toward the roof one encounters first stratified columnar (cylindrical) epithelium of the true type (nonciliated) and then pseudostratified columnar (cylindrical) ciliated, with many goblet cells (the so-called *respiratory* epithelium) Anteriorly and laterally this ciliated epithelium continues downward beyond the apertures of the eustachian tubes. With age the ciliated epithelium may be replaced by stratified squamous epithelium over large areas Some authorities feel that mild local infectious attacks (pharyngitis, etc) are responsible for this metaplasia.

The nasopharynx possesses two kinds of glands, which are usually embedded in the muscle, sometimes far beneath the elastic layer These are the tubulo-alveolar (tubulo-acinose or racemose) glands. The salivary glands proper (submaxillary parotid and sublingual) are included in this group but in the nasopharynx this type is referred to as the accessory salivary glands Here they are either the pure mucous type which secretes mucin or the mixed type which secretes a seromucinous material. The purely mucous glands are found in those places occupied by stratified squamous epithelium, and the mixed glands in regions covered by the ciliated epithelium

On the dorsal nasopharyngeal wall are found many small nodules of lymphoid tissue collectively known as the pharyngeal tonsil

Because of the wide difference of opinion among well known authorities concerning the

histopathology of nasopharyngeal malignancy no really satisfactory discussion of the subject can be given at this time. Here we shall only present the various ideas of these investigators, along with a brief discussion of the most important general characteristics of the tumors themselves Histological classifications of nasopharyngeal tumors have for the most part been inconsistent and unsatisfactory and a complete histological description of the various types would be an exhaustive procedure, as these tumors are generally so anaplastic and immature In addition, the variations in the limits observed by the individual pathologist in various circles in dealing with these tumors and the dissimilarity of pathological nomenclature for tumors in various countries all tend to discourage any real agreement on a universal classification Nevertheless in order to give a clearer presentation we have included in this text Godtfredsen s histopathological classification of nasopharyngeal tumors, which we shall use as an outline for a general discussion. Only the more important types will be discussed. Concerning the others it is of sufficient practical significance to say that all nasopharyngeal malignancies with the possible exception of the so-called *malignant chordoma*, are extremely sensitive to irradiation which is the only encouraging therapeutic recourse.

The soft tissue wall of the nasopharynx is made up of four layers mucous membrane telasubmucosa (fibro-elastic tissue), a muscular layer and loose areolar connective tissue Present also are lymphoid tissue and tubulo-alveolar (accessory salivary) glands including both pure mucous and mixed types. Consequently, a variety of tumors is to be expected Even so, tumors of epithelial origin are the most common Godtfredsen in a review of 768 published cases found the proportion of carcinoma and sarcoma to be about 55 per cent and 45 per cent respectively An analysis of his own series of 454 cases produced the same results. In both series squamous cell carcinoma and reticulum cell sarcoma were the most common, with the former predominating (47% of 678 cases and 39% of 454 cases) Ewing (1942) reports only 30 per cent squamous cell carcinoma in his series of 100 cases

CLASSIFICATION

Godtfredsen s histopathological classification of malignant nasopharyngeal tumors follows

I CARCINOMAS

- a. Squamous cell carcinoma
  - 1 Epidermal type
    - *a*. completely differentiated (cornified)
    - *b* incompletely differentiated (parakeratotic)
  - 2. Mucous membrane type
    - *a*. completely differentiated (mucous membrane type in a more restricted sense)
    - *b* incompletely differentiated (basocellular)
- b. Cylindrocellular carcinoma.
  - 1 Solid cylindrocellular carcinoma
  - 2. Adenomatous cylindrocellular carcinoma.
- c. Undifferentiated carcinoma.
- d. Carcinoma of mixed salivary gland type (cylindroma)
- e. Malignant chordoma.

II SARCOMAS

- a. Reticulum-cell sarcoma
  - 1 Main type
  - 2. Lympho-epithelioma
  - 3 Transitional cell carcinoma
- b. Lymphocytosarcoma
  - 1 Of large cells
  - 2. Of small cells
- c. Plasmocytomas
  - 1 Benign
  - 2. Malignant

CARCINOMAS

Squamous cell carcinoma. It is generally agreed that of all the carcinomas of the nasopharynx, three fourths or more are included under this heading (Fig 352 A and B) Often



Fig. 352

A Large mass of metastatic lymph nodes in the posterior triangle left side of the neck. Primary lesion carcinoma of the nasopharynx.

B Photomicrograph showing squamous cell carcinoma of the nasopharynx Grade II

and especially in this country this group with its mild variants is divided into sub-groups I through IV depending on the extent of cellular differentiation (Broders, 1932 New 1922 Stout 1941) Group IV shows the least amount of differentiation The classification is based on the extent to which the tumor cells are differentiated from their baso-cellular elements. In the classification presented here the more prevalent mucous membrane type differs from the epidermal in the absence of corneous pearls and intercellular bridges.

These carcinomas produce a characteristic *induration and soon ulcerate fungate,* and bleed. They are usually of moderate size when noted and often exhibit a deeper color than the sarcoma The surface is usually granular and infiltration of the deep tissues is a common trait.

Cylindrocellular carcinoma. These cancers according to Godtfredsen, exhibit much the same general characteristics as the squamous cell carcinomas and develop partly from the ordinary squamous epithelium and partly from the cylindrical epithelium that has undergone metaplasia (Ringertz) In this group the palisade like arrangements of the cells and their pronounced cylindrocellular character distinguish the solid type whereas, in the adenomatous sub-group *the arrangements of these cells,* although poorly delineated imitate the glandular structures of the normal tubulo-alveolar gland elements from which the adenocarcinoma is supposed to develop The cells lining the lumens are generally arranged in one layer Metaplasia is not seen in the adenocarcinoma a tendency which in the solid type enlarges the group of squamous cell carcinomas and consequently makes the adenocarcinoma group very small

Carcinomas of the Mixed Salivary Gland Type. Microscopically these often present a strikingly benign picture with their innocent looking alveolar arrangements of the cells. *The epithelial cells which are of the cuboid* type are usually arranged in two to five layers around mucus-filled lumina Clinically and macroscopically these tumors resemble the squamous cell and cylindrocellular types. The so-called mixed ectomesodermal tumors (i.e fibromyxosarcoma angiosarcoma chondrosarcoma, etc) described by Crowe and Baylor (1923) should be included here according to Ringertz and Ahlbom (1935)

Undifferentiated carcinomas include all

those of which further classification is impracticable, and the malignant chordoma represents an extreme rarity arising from the embryonal remains of the chorda dorsalis, usually in the region of the *clivus Blumenbachii* and sella

SARCOMAS

Reticulum-cell sarcoma According to Godtfredsen s classification this tumor is by far the most important sarcoma found in the nasopharynx, and in his series of 454 cases, this malignancy with a proportion of 38 per cent ran a very close second to squamous cell carcinoma (39%) in frequency It is this same group as classified here that has caused so much controversy among investigators in the past twenty years

Lympho-epithelioma is the term coined by Schmincke (1921) and Regaud (1921) to describe a nasopharyngeal malignancy which arose in a "lympho-epithelial region, and which they felt was simply an anaplastic carcinoma arising from the nasopharyngeal mucosa and containing a variable number of lymphocytes in its stroma (Fig 353 A and B) This is a view held by many today, but Godtfredsen states that in recent years investigation has established the mesodermal nature of this tumor Though holding to the ectodermal origin, Ewing (1942) says "the separation of true lympho-epithelioma from anaplastic forms of epidermoid carcinoma transitional cell carcinoma lymphosarcoma, and the like, is often difficult and at times must remain an arbitrary decision. Stout *et al.* (1941) felt it was probably a histological variant of the undifferentiated epithelioma and New (1931) expressed the belief that it belonged to the group of lymphosarcoma. Cappell (1938) was of the same opinion as Ewing Boyd (1947) refers to it as a sub-group of the transitional cell carcinoma,

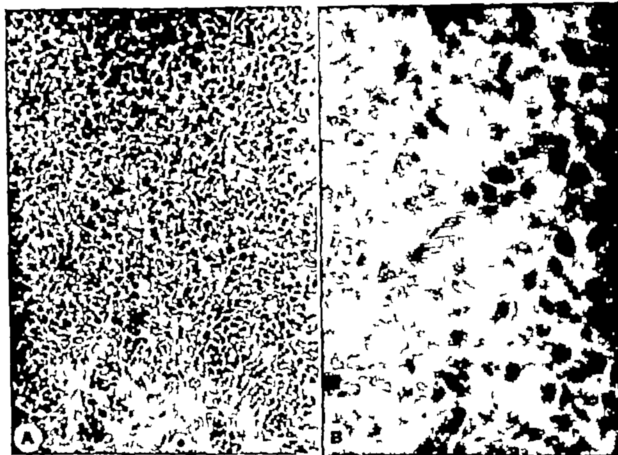


Fig. 353. Photomicrographs of lympho-epithelioma, nasopharynx
A Low power B High power

which was first described by Quick and Cutler (1927) a few years after Schmincke's introduction of lympho-epithelioma. Cutler later characterized the transitional cell carcinoma as a lympho-epithelioma without lymphocytic elements. Both tumors showed many similarities clinically, macroscopically and in regard to radiological response, as well as histologically, though silver impregnation studies have given negative results with the so-called transitional cell type. Academically speaking *transitional cell carcinoma* is a very unsatisfactory term for a malignancy of the nasopharynx, since transitional epithelium is found only in the urinary system. Ahlstrom (1943) confused the picture still further when he declared that all lympho-epitheliomas belonged with the reticulum cell sarcomas, and that the transitional cell carcinoma represented a squamous cell carcinoma of low grade differentiation. His premise stated that the sarcoma developed from lymphatic *tissue and was therefore characterized by a* cytoplasmic reticulum, argentophil fibrils, and to a varying extent an admixture of lymphocyte like cells, the surface epithelium being generally intact.

The term *reticulum cell sarcoma* was first used by Ewing in 1914 in reference to a subsection of the primary tumors of lymph glands. Godtfredsen states that it may be asserted from good authority that malignant solitary tumors of the lymphosarcoma and reticulum cell sarcoma types are found.

Most pathologists are now in complete agreement to the impossibility of ever separating the lympho-epithelioma from the so-called *transitional cell carcinoma* of Quick and Cutler. Furthermore, according to Godtfredsen, the majority *of the more recent works in which* silver impregnation has been used tediously refer the lympho-epithelioma and consequently its usually recognized coincident, the transitional cell carcinoma, to the reticulum cell sarcoma group (Bang, 1941; Edling, 1938; Ringertz, 1938; J. J. Munro Black, 1938).

Lymphocytosarcomas. In Godtfredsen's classification this term designates a primary tumor of the nasopharynx, although lymphosarcoma may occur here as part of a systemic involvement. When compared with the reticulum cell sarcoma, this group is apparently conspicuously lacking in cytoplasmic reticulum and dominated by *non-syncytial elements of* the lymphocytic type.

Plasmocytomas. These are tumors resulting from proliferation of elements resembling more or less normal plasma cells. Under this heading are included the medullary (multiple myelomas) and the extra-medullary types. The latter form is of chief significance here and is found exclusively in the mucous membranes of the upper air passages and conjunctivae. According to Oberling (1928) they arise from lymphatic tissue in these areas. They may be single or multiple, benign or malignant, and on the whole, they are comparatively rare, especially in the nasopharynx. These, like the lymphocytosarcomas, are conspicuously lacking in cytoplasmic reticulum. They are dominated by non-syncytial elements *in the form of plasma* cells. Clinically, the malignant forms resemble the reticulum cell and the lymphocytosarcomas, except that there has been no tendency to ulceration demonstrated.

In general, the sarcomas in contradistinction to the carcinomas are usually flatter lesions in the early stages, and tend to displace submucously (especially the lympho-epithelioma) rather than infiltrate. Early invasion of the lymph nodes resulting in bulky lymphadenopathy is another rather characteristic feature. These tumors are usually fairly firm and relatively non-vascular, and may attain considerable size without ulceration.

Godtfredsen points out an interesting fact in the histological difference between the cases *with ophthalmo-neurological symptoms and* those without, the former including the greater number of squamous cell carcinomas and cylindromas, but a smaller number of plasmocytomas and lymphosarcomas than the latter.

ANATOMICAL PATHWAYS

Lymphatics. The superior deep cervical nodes lying along the upper portion of the internal jugular vein beneath the sternocleido-

mastoid muscle and in close relationship to the accessory nerve (XI) drain all parts of the mouth, tongue, fauces, and the upper part of the pharynx, and these receive efferent vessels from all other nodes of the head and neck except from the inferior cervical group

The walls of the nasopharynx are richly supplied with lymph vessels, particularly in the region of the pharyngeal tonsil From here the collecting trunks pass laterally or posteriorly along the tela submucosa and then downward to any one of several groups of nodes Apparently some trunks by-pass these minor groups and enter directly into the superior deep cervicals, but for the most part they first establish contact with the retropharyngeal, deep facial, or subparotid groups

The retropharyngeal nodes are one to three in number and are situated behind the upper part of the pharynx in front of the arch of the atlas. Their afferents drain the nasal cavities, the nasal part of the pharynx, and the auditory tubes. Their efferents pass to the superior deep cervical nodes

The deep facial group (internal maxillary nodes) lies beneath the ramus of the mandible on the outer surface of the pterygoideus externus. Their afferent vessels drain the temporal and infratemporal fossae and the nasal part of the pharynx Their efferents pass partly to the superior deep cervicals and partly to the submaxillary nodes which lie beneath the body of the mandible in the submaxillary triangle. These, in turn, drain into the superior deep cervical group

The subparotid nodes are situated along the lateral walls of the pharynx and drain the nasopharynx as well as the posterior part of the nasal cavities. These likewise send their efferent vessels to the superior deep cervical nodes

From the superior deep cervical group efferents pass to the inferior deep cervical nodes and jugular trunk which joins the thoracic duct on the left and on the right terminates in the junction of the internal jugular and subclavian veins.

The lymphatic channels through which the expansion of a nasopharyngeal malignancy may take place have already been described. It is very likely that lymphogenous extension here is chiefly embolic in nature, as was concluded by Ewing in regard to buccal and lingual cancer No respect for the anatomical midline is observed, consequently lymphatic involvement may be ipsilateral contralateral, or bilateral. Invasion of nodes (mediastinal, abdominal, etc.) other than those directly draining the nasopharynx, has been noted in some instances Hematogenous extension to the skeletal system, and parenchymatous organs (lungs, liver, spleen, adrenals, etc.) is not infrequent.

Routes of extension. The nasopharynx is situated above the soft palate and behind the nasal cavities, and any structure in this vicinity is vulnerable to direct attack by a malignancy developing here. Invasion may take place in almost any direction, either directly by continuity or indirectly by lymphogenous and hematogenous metastases, however, there are certain recognized pathways that apparently offer a more receptive course.

In an anterior direction the expansion may involve the nasal cavity, the conchae, the antra and the ethmoid cells. Further extension through the cribriform plate into the anterior cranial fossa and through the pterygopalatine fossa, after penetrating the pterygoid process, into the superior orbital fissure is possible.

Posteriorly, even less resistance would be encountered as the tumor proceeds through the retropharyngeal connective tissue space to the prevertebral fascia, posterior cervical muscles, and anterior arch of the atlas. Invasion of the cervical canal and posterior cranial fossa may conceivably take place from here

In an inferior direction the tumor may penetrate the hard and soft palate to invade the oral cavity the palatine arches, and the palatine tonsils.

Laterally expansion of the growth may involve the pterygoid and palatine muscles (especially the levator veli palatines) in the deep portion of the retromandibular region The third branch of the V nerve and vagus

(X) might be included here Still further extension to involve the parotid gland, VII nerve, and cheek is possible. Extension along the eustachian tube to present in the external auditory canal has been reported

Finally the neoplasm may expand in a superior direction This occurs with surprising frequency and usually presents the more distressing symptoms. This invasion most often takes place through the medial part of the foramen lacerum which leads into the middle cranial fossa from the fossae of Rosenmüller This represents a distance of about 1 cm and involves only soft tissue however a certain amount of bone erosion apparently takes place when the tumor begins to expand intracranially and extradurally The cavernous sinus may be invaded at this point As the dura mater forms an extremely resistant bulwark to malignant expansion, further growth usually takes place in an extradural fashion. From the foramen lacerum the tumor may pass along the carotid groove in intimate relation to the internal carotid artery and thence through the superior orbital fissure into the orbit Expansion into the anterior cranial fossa by the ala parva may occur Posterior extension passing by the petrosal tip of the temporal bone into the posterior cranial fossa may take place. Expansion upward from the nasopharynx through the body of the sphenoid and the sphenoid sinus to the dura cavernous sinus or pituitary body has been reported.

Symptomatology

As one would expect the symptoms of an untreated nasopharyngeal malignancy exhibit a very persistent and progressive nature Another rather constant finding is the unilateral character of the disturbances produced Godtfredsen (1944) presents many interesting correlations between tumor types and the frequency of various signs and symptoms but he also recognizes the fact that epithelial and mesothelial tumors are capable of producing similar results

The symptoms of nasopharyngeal malignancies are divided into three groups those due to the local lesion in the nasopharynx those due to direct extension of the tumor from this area, and those due to metastases.

(A) THE LOCAL LESION

Characteristically the primary lesion causes few if any symptoms in the early stages. The time of onset of the local symptoms, their nature, and the size to which the tumor must grow to produce them are determined largely by the location of the mass, the general characteristics of the growth and the physiological anatomy of the individual nasopharynx The most common sites of origin are high on the posterior wall to either side of the midline or in one of the fossae of Rosenmüller

Nasal Obstruction. Because of the shape and size of the nasopharynx a rather large mass can be accommodated without causing complete obstruction to nasal breathing Nevertheless, obstruction of varying degrees is usually the most frequent of the local symptoms. In association with this the patient will usually complain of an unpleasant pressure in his throat on swallowing due to interference in the elevation of the soft palate. Oral breathing and a loss of nasal resonance are noted

Discharge. Nasal obstruction results in an unusual accumulation of nasal secretions producing an anterior discharge and a dry throat This drainage is accentuated by the local infection that frequently intervenes and a mucopurulent discharge results. Trauma from blowing the nose or infectious erosion of the tumor may give a blood tinged nature to the secretions. Necrosis may produce a fetid odor

Epistaxis. This may vary anywhere from a frank exsanguinating hemorrhage to the blood tinged discharge described above. Because of its abrupt onset and alarming nature it is often the first local symptom to call attention to the pathology

Unilateral deafness. When the growth arises within or near the orifice of a eustachian tube air conduction deafness of various degrees will occur In 1911 Trotter first described his now classical triad from six cases of nasopharyngeal malignancies which arose on the lateral wall in

the region of the tubal orifice and produced unilateral deafness of the air conduction type, together with auriculofacial neuralgia (third branch of V) and unilateral paralysis of the soft palate (X) all apparently due to an extra cranial lesion Obstruction of the tubal orifice may occur from pressure of a tumor growing in the fossa of Rosenmüller, however, it has been estimated that a mass must reach a diameter of 2 cm. or more to produce obstruction. Persistence of the tubal occlusion will cause a hydrops ex vacuo in the middle ear which usually then becomes infected The disturbing symptoms will be those of otitis media. It is important to remember that impaired hearing may also result from intracranial invasion and subsequent eighth nerve damage. Tinnitus is another otological symptom that may result, usually in association with impaired hearing due either to the local lesion or to intracranial invasion The administration of a tubal air douche may be of real value in determining the etiology

Pain. The nasopharynx is rather insensitive to pain, consequently this complaint is not encountered very early in the disease however a severe associated rhinopharyngitis may produce some local discomfort Occipital headache on the other hand is rather frequently complained of even when the tumor is apparently well localized, and is probably due to erosion of the base of the skull. The usually more disturbing pains result from complicating acute otitis media (earache) and sensory nerve invasion (trigeminal neuralgia, etc.)

(B) DIRECT EXTENSION OF THE TUMOR

The symptoms produced by direct extension of a tumor from the nasopharynx are chiefly neurological in origin. Consequently the homolateral nature of the resulting symptoms is a rather constant feature. The actual point of injury to the nerve may be intracranial or extracranial depending upon the selected pathway of expansion Neural damage may vary from extrinsic compression to invasion and destruction and coincidentally the local motor and sensory responses will vary from early excitation to diminished function and finally paralysis. Consequently, the resulting picture will show varying degrees of muscular fibrillar activity paralysis and atrophy with sensory changes varying from neuralgia to total anesthesia over the respective distribution of the involved nerve, however as one would expect with a lesion of this nature, neuralgia and diminished motor function dominate the scene Fortunately irreversible changes usually do not occur until the more advanced stages. Complete subsidence of symptoms is the usual response to adequate therapy, and even spontaneous remissions of various durations are occasionally noted

In this discussion we will not include all the various symptom complexes produced by interruption of each of the twelve cranial nerves. Only those most commonly involved by intracranial invasion of nasopharyngeal malignancies, along with some of the better known syndromes produced, will be presented

As the growth penetrates the base of the skull through the foramen lacerum, the abducens nerve (VI) is often first encountered The fifth third and fourth nerves emerge nearby, and are therefore next in frequency of involvement. It should be remembered that the cavernous sinus occupies this region and also that a very small neoplasm can cause a simultaneous lesion of cranial nerves III IV V and VI (Syndrome of Foix 1920) Some authorities have found the fifth nerve the most often affected in intracranial invasion, especially the maxillary division Van Metre in his series recorded that out of those cases presenting neurological disturbance initially 85 per cent gave fifth nerve pain as the first symptom Godtfredsen reported 16 per cent of his cases as showing ophthalmoneurological disturbances initially with 71 per cent of these presenting with a trigeminal neuralgia. Since the fifth nerve pain is a subjective symptom commanding immediate attention and the ophthalmic findings with the exception of diplopia are more of an objective nature and therefore may go for some time without recognition, some variations in these reports are to be ex

pected. Nevertheless, it is generally agreed *that when nasopharyngeal malignancies invade the cranium* the symptoms most often produced particularly in the early stages are ophthalmic (diplopia strabismus ptosis fixed mydriasis) or are of a trigeminal neuralgia and usually both are present

As the growth extends forward from the region of the foramen lacerum the optic tract may be invaded with the classical Jacod s triad resulting (1934) This syndrome of trigeminal neuralgia of the ganglionic type amaurosis and ophthalmoplegia is produced by involvement of cranial nerves II through VI If the third and fourth nerves have previously escaped they along with the second will usually be included with the invasion of the superior orbital fissure Exophthalmos from total ophthalmoplegia may occur but it is never so pronounced as it is in primary invasion of the orbit The olfactory nerve is apparently rarely involved and unilateral paralysis of it is difficult to prove

With extension of the growth posteriorly the VII and VIII nerves might be involved in the region of the petrous pyramid however due to their protected position on the back of the petrous bone and their immediate entry into the internal auditory meatus they frequently escape injury *Erosion of the petrous tip produces* a syndrome originally described by Gradenigo (1904) in association with middle ear infection and petrositis This is known as Gradenigo s triad and includes temporo-parietal pain (V) abductor paralysis (VI) and petrositis. Further extension into the posterior cranial fossa with involvement of nerves IX X and XI in the region of the jugular foramen resulting in the development of the syndrome of the jugular foramen (Vernet, 1916) may occasionally take place In this area invasion of the twelfth and jugular sympathetic nerves may *also occur* and more recent writers tend to include them in the jugular foramen syndrome Ipsilateral paralysis of all twelve cranial nerves was described in a thesis by Garcin (1927)[1] Additional symptoms of intracranial invasion are non-specific headache and projectile vomiting Bone erosion should be listed as an objective finding as it is demonstrated roentgenologically Trismus is sometimes seen and may be due to fifth nerve involvement but more often direct invasion of the masticatory muscles is responsible

(c) METASTASES

Metastases may be divided into proximal and distal The proximal includes only the lymph nodes of the head and neck whereas, the skeletal system parenchymous organs, and other lymph nodes are included in the distal group

The deep cervical nodes at the angle of the jaw are most frequently involved further extension to the clavicle and posterior triangle of the neck may occur (Fig 354) Metastatic cervical nodes are present in sixty to eighty per cent of the cases of malignancy of the nasopharynx, according to most series, and in about half of the patients this is the first complaint Even higher figures are recorded in cases of lymphoepithelioma

Early in the course of the disease the lymphadenopathy is usually unilateral (either ipsilateral or contralateral) but later stages particularly in those untreated characteristically produce a bilateral enlargement. Growth is generally rapid so that in less than a year's time normal-sized nodes may become two or three inches in diameter These are frequently matted together and exhibit a hard rubber like consistency Enlargement is usually of a painless nature but subjectively some limitations of movement of the head and neck may be noted Even lingual (invasion of XII) and facial (of VII) paralysis may result from excessive cervical node enlargement Invasion of the retropharyngeal nodes will often produce an inward bulging of the posterior pharyngeal wall just above the upper pole of the tonsil.

[1] Cited by Goldfredsen Garcin R *Le syndrome paralytique unilatéral global des nerfs craniens* Paris. 1927 18 225 ; 71 127

With involvement of the deep jugular chain of nodes and invasion of the sympathetic trunk and ganglia, Horner's syndrome may be present. The ninth, tenth, eleventh, and twelfth cranial nerves may also be involved by nodal metastases in this region.

Martin and Blady reported that 34% of their patients had distant metastases on admission. Almost any part of the body may be involved, but the most frequent sites are the lumbosacral area, liver, lungs, mediastinal and abdominal nodes. Symptoms here are similar to those produced by metastases of other rapidly invasive neoplasms.

Diagnosis

Unfortunately, early recognition of a nasopharyngeal malignancy is an all too infrequent occurrence. The average duration of symptoms prior to diagnosis is about twelve months, but periods as long as three and four years have been reported. This delay is partly excusable since a large percentage of these tumors give few if any early local symptoms. Also because of its location the nasopharynx is difficult to examine and to do so satisfactorily usually requires special training. Many times negligence, either on the part of the patient or on the part of the physician or both, has been the sole offender in delaying diagnosis. In an investigation of seventy nine serial cases of nasopharyngeal malignancies by New of the Mayo Clinic (1922), seventy four were found to have undergone some type of operation on the head or neck for relief of symptoms produced by the malignancy, but in no instance was the underlying etiology recognized. From this it is obvious that certain criteria should be formulated the recognition of which should demand a thorough investigation of the nasopharynx. If any of the previously described local symptoms of nasopharyngeal malignancy which are more often attributed to relatively innocuous conditions, such as acute coryza, sinusitis, etc., should show persistence or progressiveness, it is essential that the patient have a careful examination of the nasopharynx by a well qualified specialist. Also all ophthalmic or cephaloneurological disturbances, particularly if of a unilateral nature which are not satisfactorily explained, and all cervical node enlargements require thorough investigation of the entire pharynx and oral cavity with repeated biopsy of any and all suspicious areas. Biopsy is mandatory of all enlarged, firm cervical nodes, especially those persisting for two or three weeks, with or without symptoms relative to the nasopharynx.



Fig. 354. Large metastatic carcinoma of the neck. *Primary lesion type IV* squamous cell carcinoma of the nasopharynx.

Ewing states that it is never justifiable to adopt the diagnosis of a primary carcinoma or endothelioma of the cervical nodes unless a thorough and repeated search is made of the entire intraoral and nasopharyngeal fields.[1] Martin and Blady (1940) feel very strongly that cervical lymphadenopathy in the adult is almost always malignant and usually metastatic from a primary lesion in the upper respiratory or alimentary tract. In some instances

[1] According to Ewing, primary endothelioma of lymph nodes was described by Chambard in 1880 under the term *primary carcinoma*. Ewing himself believed at one time that these endotheliomas were comparatively frequent in occurrence. They appeared to develop from the endothelium of the lymph and cavernous sinuses. More recent studies have shown that true endothelioma of lymph nodes is a rare disease, while secondary carcinoma, which presents many of the features of endothelioma, is common.

the symptoms of the metastasis will so completely overshadow those of the primary lesion that it may be disregarded completely. In a small number of cases according to Godtfredsen the primary tumor has a curious submucous mode of growth during a period of six to twelve months when it is impossible to visualize it by post rhinoscopic examination. However before suspicion can be allayed the nasopharynx must be adequately examined by anterior and posterior rhinoscopy with throat mirror and with a nasopharyngoscope. When possible and especially when suspicion is aroused direct visualization and palpation under anesthesia is advised. As advocated by Broyles (1948) careful inspection and palpation of the nasopharynx at the time of routine tonsillectomy and adenoidectomy might prove well worthwhile. In suspected cases repeated representative biopsies of any abnormal areas should be taken. Sections or aspiration biopsies of enlarged nodes, particularly in the cervical group will frequently give useful information.

Stereoscopic x ray films of the base of the skull in the submento-parietal position will show confirmatory bone erosion in nearly a third of the cases. Intracranial nerve involvement has been reported without evidence of any bone erosion on x ray and conversely involvement of the base of the skull may be demonstrated without cranial nerve symptoms. Fourteen out of twenty-one cases studied roentgenologically by Van Metre showed x ray evidence of tumor. Lateral films will sometimes show displacement of the nasopharyngeal air column which is usually seen overlying the superior rami of the mandible. Late cases might reveal pulmonary or lumbosacral metastases. Except in the very late stages when cachexia is marked no significant change in the blood picture can be demonstrated unless of course repeated frank epistaxis has occurred.

A complete list of the possible differential diagnoses of malignant nasopharyngeal tumors would include a host of benign and malignant lesions various infectious proc... d nasal septa non-specific neur... o- ances and the like. In this disc... r we shall include only those most commonly encountered. In regard to the local lesion all the causes of unilateral deafness must be considered. Excessive cerumen is by far the most frequent offender. Fibromas, syphilitic lesions, protruding nasal polyps and enlarged adenoids may arouse suspicion. In the ophthalmoneurological group of symptoms, tic douloureux may be confused with the early stages of malignant invasion. A history of trigger zones, the absence of objective sensory and motor disturbances, and the singularity of the involvement will usually distinguish a true tic. Primary ophthalmic tumors must occasionally be ruled out. Infrasellar pituitary tumors may be disconcerting, but these more often produce bitemporal hemianopsia and other localizing signs. Petrositis and sphenoidal sinusitis may at times cause difficulty. Cervical node enlargement may result from other malignancies of the upper respiratory and alimentary tracts, as well as tuberculosis, other infectious processes, generalized lymphoblastomas and the like. In differentiating all of these a careful observance of the generally recognized diagnostic principles should suffice. Biopsy of any suspicious area in the nasopharynx and/or any persistent cervical lymph node is mandatory.

Prognosis

Malignancy of the nasopharynx carries a high mortality. At best one can expect a 75 per cent fatality and the statistics of some clinics are closer to the 100 per cent mark. Some of the most encouraging results are recorded by Martin and Blady (1940) who reported 25 per cent five-year cures of 87 cases, and by Godtfredsen (1944) who showed 22 per cent of 266 cases to be symptom free after five years. Godtfredsen however is of the opinion that a cure cannot be definitely declared complete until the patient has been free of symptoms for at least nine years. New in 1931 reported only four of 194 cases as showing five year ... For the most part this wide variati... might be due to the more mod... developments in roentgen the ap...

Probably the most encouraging part of the picture lies with the sixty to seventy per cent who obtain complete relief of symptoms for weeks and months following irradiation therapy Following irradiation complete regression of the primary lesion as well as the cervical metastases may occur, and even profoundly ill patients at times receive dramatic relief New states that those adequately treated live five times as long as those not treated. In the treated groups, the average length of life for those dying from the malignancy seems to vary from one to two and a half years after the onset of the first symptom. This average life span for Godtfredsen s series was 28 7 months, and in the series reported by Thompson and Grimes (1944) it was 23 months New recorded an average survival period of 34 months. The usual processes precipitating death are massive intracranial invasion, erosion of large vessels, or progressive cachexia In about one fourth of the cases metastatic lesions are chiefly responsible for death

Assuming that the patient is adequately treated, there are certain factors that should be considered before a reasonable prognosis for any case of nasopharyngeal malignancy can be offered. Prominent among these is the age of the patient. The poorest results are reported in the young and elderly groups. The highly malignant nature of these tumors in the young and the general debility of the aged are responsible. Some investigators aver that these neoplasms carry a slightly graver prognosis in males, but universal agreement on this sexual inequality is not found As one would expect those cases showing ophthalmoneurological symptoms or metastases or both are rather unfavorable Godtfredsen concluded that the chances of survival were five times as great for the patients with sarcoma as compared with those having carcinoma The lympho-epithelioma has the highest rate of cures and the squamous cell carcinoma the lowest with practically no cures among the highly differentiated forms. If a patient remains symptom free for a year following treatment then his chances of complete cure are markedly enhanced, as better than two-thirds of the recurrences occur within the first twelve months. Unfortunately, recurrences are often very resistant to irradiation.

RADIATION TECHNIC FOR MALIGNANT TUMORS OF THE NASOPHARYNX

Treatment of nasopharyngeal malignancy includes the primary lesion and lymphatic drainage area. Since these tumors metastasize early the upper cervical nodes should receive external irradiation whether they are palpable or not. The technic of treatment depends on whether the lesion is limited to one side or involves one side with extension beyond the mid line Patients who have the lesion limited to one side are treated as follows

Two external ports are used one lateral and one anterior The lateral port is a projection to the external surface of the body of the region involved by the malignancy Ports may vary from 4 x 5 cm to 10 x 10 cm., depending upon the size of the lesion. The anterior port directs the beam of rays through the maxillary sinus. The size of this port is usually 5 x 6 cm Patients are treated three times weekly, and the ports changed on alternate days, giving 300 r measured in air per treatment. The factors for this treatment are as follows 200 Kv 50 cm TSD 15 Ma , and ½ mm Cu + 1 mm. Al filter The total dose to each port is carried to skin tolerance, the amount varying with the size of the port and the condition of the patient s skin being in the neighborhood of 2000–3000 r, measured in air Occasionally, when the lesion is sufficiently posterior we add a third port to the series an intraoral cone pointed to the region of the tumor The factors for the intraoral cone are 200 Kv 35 cm. TSD 15 Ma., and ½ mm. Cu + 1 mm. Al filter

When the lesion extends beyond the midline, two ports on the opposite side are added to those already mentioned, that is, one laterally and one anteriorly When a sufficiently large tumor dose is not obtained by these methods, the treatment is supplemented by the implantation of radon seeds or application of radium element Radium tubes having 1 mm platinum and iridium (10%) walls are placed in rubber

cots of suitable size to cover the primary growth and are inserted into the nasopharynx through the nostrils and held in place by petrolatum gauze The combined treatment by x ray therapy and radium or radon should total about 7000 to 8000 roentgens. Treatment of cervical lymph nodes is outlined in Chapter XIX.

BENIGN TUMORS OF THE PHARYNX AND NASOPHARYNX

Juvenile Nasopharyngeal Fibroma

Nasopharyngeal fibroma is not a common tumor and occurs usually in boys from the ages of six to twenty-five years. One of our cases occurred in a girl ten years of age The oldest patient we have treated was twenty five years of age when his symptoms began. Other names applied to this tumor are *juvenile nasopharyngeal angiofibroma myxofibroma juvenile basal fibroma fibroids of the nasopharynx etc*

Histogenesis

Ewing (1928) quotes Bensch (1878) as attributing the origin of intrapharyngeal tumors to the basilar fibrocartilages, the upper cervical vertebrae, or the internal lamina of the pterygoid process and the origin of pharyngeal growths to the cartilage of the foramen lacerum anterior or the sphenopalatine fossa Since these tumors occur most commonly in boys and are never seen after the age of twenty-five or thirty attention has been focused to their relationship with sex development Further study is necessary to clarify the subject

Martin Ehrlich and Abels (1948) in studying a series of cases, found that the tumors in younger subjects are more vascular than those in older patients. These authors maintain that in the beginning the growths are principally angiomatous rather than *fibromatous and go* on to say that "if estrogenic stimulation is a factor in the etiology of these tumors, their histogenesis can be reasonably explained as an overgrowth of vascular tissue in the nasopharynx a *result of an abnormal* stimulus to the local circulation. The fibromatous elements *at first being only supporting* stroma of the tumor develop as a structural component and become predominant as the estrogenic effect is lessened An identical phenomenon is the gradual replacement of the angiomatous elements by fibrous tissue as seen in ordinary hemangiomas following spontaneous or therapeutically induced sclerosis of the blood vessels.

Bensch quoted by Crowe and Baylor (1923) states that the tumors tend to disappear at the age when sphenoid and basilar processes *of the occipital bones unite and ossification of* cervical vertebrae is complete

Histology

Nasopharyngeal fibromas are composed of vascular connective tissue. The proportion of vascularity varies with different tumors. The blood vessel development may progress to the point where the tumors appear as cavernous angiomas in a fibrous stroma others are composed of densely cellular and occasionally myxomatous fibrous tissue. In the older tumors, the vascularity is less and the fibromatous elements persist Embryonic connective tissue is present often leading to the diagnosis of sarcoma. The connective tissue elements are often compact and appear as spindle and star shaped fibroblasts.

In two of our cases, the preoperative diagnosis of fibro-osteoma was made because bony spicules were found in the biopsy specimens.

Pathology

Nasopharyngeal fibromas occur as encapsulated tumors often attached by a primary pedicle at the point of origin. Most of our cases seem to have sprung from the walls of the nasopharynx They destroyed the surrounding soft tissues and bone by pressure Ulceration, *either from pressure or infection*, causes secondary attachments in these secondary attachments, parasitic blood vessels develop which may be as large or larger than those in the original pedicle One of our recent cases was densely adherent in the wall of the nasopharynx

and also to the posterior wall of the antrum (see Fig. 355 E)

The presence of large blood vessels causes brisk bleeding, both following biopsy and spontaneously from infection and ulceration. At operation often there is severe hemorrhage due to the numerous large blood vessels and to the lack of contractility of the tissues around the vessels. The tumor itself is hard and cartilaginous and covered by an intact mucous membrane unless injury has caused ulceration. The color varies from deep red to cream depending upon the vascularity Martin et al., state that in the older patients or those in whom the vascularity has been reduced by radiation or sex hormone therapy the color is paler In our last case (a boy of 10 years) however on whom we operated before any therapy had been given the tumor was pale with large blood vessels scattered throughout (Fig 355)



Fig. 355 (A–B)

A. White boy aged 10, with large nasopharyngeal fibroma—symptoms 2 years. Left nasal obstruction swelling left cheek.
B Semi-firm mass presenting in left hard palate and gingiva with area of fluctuation

Clinical Behavior

The early symptoms are nasal obstruction and bleeding The amount of bleeding in the early course of the disease depends upon the presence of ulceration and secondary infection Some of our largest tumors have not bled prior to operation Because these tumors are so vascular and bleed briskly on biopsy some clinicians refrain from taking specimens for microscopic examination Other symptoms are swelling of the face displacement of the eyes, interference with hearing

Nasopharyngeal fibromas are benign, but recur frequently None of our cases have metastasized and none have shown definite sarcomatous changes on histological study One case in a tweny five-year-old man was diagnosed sarcoma on biopsy through a tooth socket but this early diagnosis was changed

after the operative specimen was studied Crowe and Baylor (1923) Martin, et al. (1948) report no definite malignancies as evidenced by metastases In one of the cases reported by Martin et al., localized areas of malignant

As has been mentioned these tumors are no seen after the age of twenty five or thirty an therefore it is assumed by some authors tha they have a limited course Even though thes tumors are not malignant the great danger t

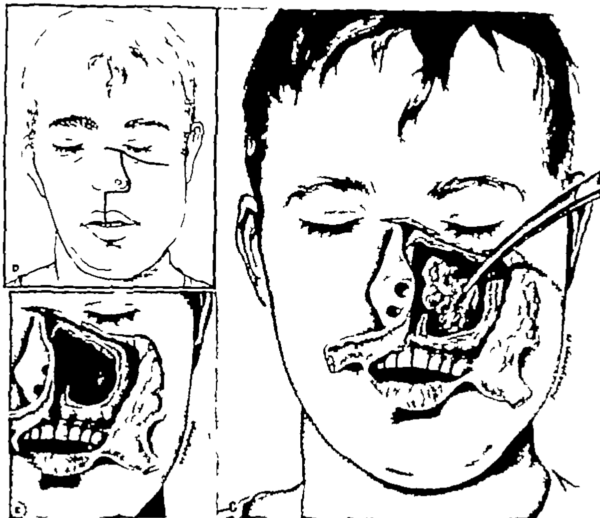


Fig 353 (C D and E)

C Tumor exposed through Fergusson incision as modified by Longmire (D) (see text) filling antrum, left nasal cavity deflecting septum to right and nasopharynx.

D Electrosurgical removal—extensive hemorrhage from large veins, requiring transfusion of 2500 cc of whole blood during operation in spite of preliminary ligation of external carotid artery

E. Remaining tumor attached to posterior antral wall and posterior wall and vault of nasopharynx Radium applied directly to both areas—dose 975 mg hr (1 mm pl filter) Palate not involved by growth and left intact. Uneventful recovery One month later hemorrhage controlled by packing.

transformation were noted but there has been no evidence of metastases. Wirth and Shimkin (1943) reported a chondrosarcoma of the nasopharynx which simulated a juvenile angiofibroma clinically and on biopsy Further study proved this to be a definitely malignant tumor *and should not be classed as nasopharyngeal* fibroma

life lies in ulceration and secondary hemorrhage We lost one of our patients by uncontrollable hemorrhage many years ago now *we would not hesitate to remove such a hemorrhag*ing tumor through the cheek as a lifesaving procedure With blood bank at hand, patients are carried through safely in spite of the excessive bleeding



Fig. 356 A–D 12 year-old white boy with large nasopharyngeal fibroma

A. Note swelling at the inner canthus of the left eye (4/5/46)

B Photograph (3/6/47) Growth had extended in spite of x ray and radium treatment. Note exophthalmus and displacement of the left eye laterally

C A P roentgenogram showing clouding left antrum and destruction of all antral walls, except floor Floor of orbit partially eroded.

D Roentgenogram base of skull, obliteration of normal markings, especially on left. The operation was performed through an incision extending up the middle of the lip around the left ala of the nose to the inner canthus of the eye A second incision devised for this case by William P Longmire was made obliquely across the nose The nose was turned back and a huge tumor presented filling the nose left antrum part of the orbit and the entire nasopharynx. All bone destruction was by pressure. The only attachment of the tumor was in the vault of the nasopharynx.

Diagnosis

The clinical history is so typical and the physical findings so characteristic that the diagnosis is usually not difficult However an-ing and eroding nearby structures by pressure in a youth are the chief points of diagnosis.

In all cases x ray films of the sinuses and base of the skull should be made in order to study the extent of the growth and the amount

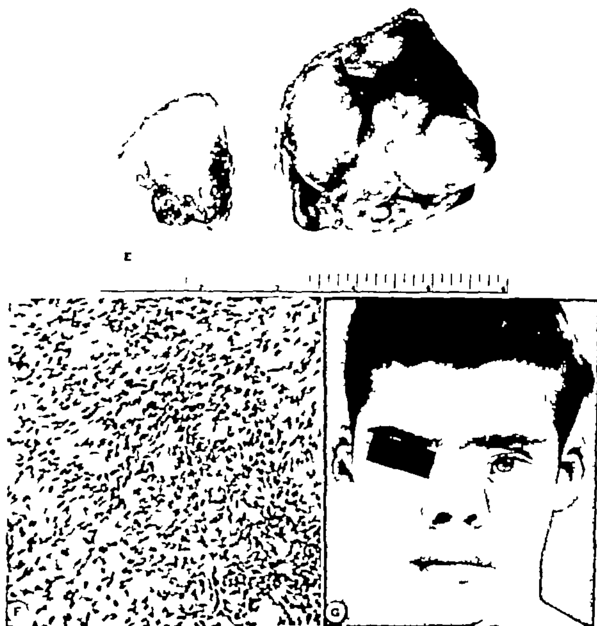


Fig. 356 (E–G)

E. Gross specimen
F Photomicrograph nasopharyngeal fibroma
G Postoperative result. To date there has been no recurrence

gioma arcoma lymphosarcoma angiosarcoma myxosarcoma, and cancer all must be differentiated by microscopic examination. The presence of nasal obstruction by a large tumor growing rather rapidly with or without bleed-

of bone destruction Such x ray films are a guide both in directing the x ray beam for therapy and in operative procedures.

A large massive tumor may cause some opacity of the sinuses, sufficient at times to arouse

suspicion of the presence of bone in the nasopharyngeal fibroma. In one of our cases there were many bony spicules which added to the opacity noted in the x ray Most of the bone destruction is found to be due to pressure rather than direct bone invasion

Treatment

As has been pointed out in the discussion of clinical behavior, it has been the belief of many clinicians that the treatment of these tumors should be palliative until the patients become older and the tumors spontaneously regress. We feel that this is a dangerous hypothesis on which to base treatment Ulceration with hemorrhage may be lethal The tumors become massive and destroy the surrounding structures by pressure, causing marked displacement of the eyes and cheeks and surrounding tissue meningitis may occur For these reasons we think that a definite well-planned course of treatment is indicated.

Mikulicz (1899) quoted by Crowe and Baylor (1923) gave twenty different methods of treatment Modern-day therapy is divided into three types radiation surgery and hormone therapy

SURGERY

Surgery is the oldest form of therapy and will be discussed first. Since this tumor is clinically benign, surgical approach by any convenient route which will permit complete removal of the growth would seem to be the method of choice However many of these tumors have become massive when first seen so that surgery might be dangerous and, unless properly carried out, disfiguring Surgical intervention is fraught with severe hemorrhage and possibly meningitis, the latter less likely when antibiotics are used pre and post-operatively Small tumors may be removed through the nose or through the open mouth from behind the palate. This is a dangerous procedure and if attempted all preparations for control of hemorrhage and replacement of lost blood should be made ahead of time Some of our cases have come to us for postoperative radiation after incomplete removal. In these cases a combination of radiation therapy and surgery was continued with good results Larger tumors require removal through a Ferguson incision in the cheek. This operation is not as disfiguring a procedure as it might seem. The cases illustrated in Figure 355 and 356 as well as several others, have had good results following this surgical approach

Ligation of the external carotid artery It is a safe rule that the external carotid artery should be ligated on one or both sides, depending upon the location of the tumor as determined by careful study Ligation of one or both of these arteries does not always completely control hemorrhage because of the parasitic blood vessels growing from various locations. Then, too the primary pedicle may be in the midline in the base of the skull where blood vessels would not be tributaries of the external carotid artery When ligation of both external carotid arteries is necessary the ligatures should be placed distal to the lingual arteries to prevent sloughing of the tip of the tongue.

Radical surgical excision. Before any surgical procedure is attempted, an adequate supply of blood should be on hand to meet any emergency Careful clinical and roentgenological study furnishes a fair idea of the extent of growth as a basis for deciding whether an intraoral approach or a transfacial approach is indicated Small tumors can be removed through the nares medium sized ones by a combination of approach through the nares and through the mouth Large tumors, often disfiguring and invading the antrum, nose, nasopharynx, pterygoid fossa, and even the orbits, are best reached through a Ferguson incision in the face William P Longmire (1947) (personal communication) extended the Ferguson incision across the bridge of the nose in such a fashion as to turn back the nose (Fig. 355 C D and E) increasing the amount of exposure through the face With this incision usually there is no loss of the alveolar process of the upper jaw or the palate, so that facial disfigurement and oral dysfunction are at a

minimum and a prosthesis is not necessary We have employed this incision twice since with successful exposure of the nasal cavity and nasopharynx John E. Brodley uses this incision for approach to inflammatory and neoplastic lesions in the nasal passages and sinuses. He and Longmire (1949) described the procedure in detail

In Chapter XIII Tumors of the Paranasal Sinuses and Nasal Mucous Membrane a detailed description of this operation is given Briefly it is as follows A Ferguson incision is made at the midline of the lip around the ala of the nose on the affected side up along the side of the nose to just below the inner canthus of the eye The horizontal limb of the Ferguson incision extending laterally beneath the edge of the orbit and out to the zygoma may or may not be used as the case indicates Such a horizontal incision is necessary if the antrum and lateral face structures are involved. Should the growth extend more medially into one or both nares, then the nose is turned back This is done by a diagonal incision across the bridge of the nose to the opposite side The nasal bone and cartilage are cut with bone cutters or chisel at the junction of the malar and nasal bones along the lateral border and across the bridge of the nose to the opposite side The septum may or may not be incised and deflected The nose is then retracted to the opposite side The cheek flap is also dissected back giving adequate approach to the antrum and nasal cavities and nasopharynx The tumor in the case in Figure 356 was pedunculated and attached at only one place, namely the vault of the nasopharynx. There were no parasitic blood vessels Consequently the growth was shelled out in pieces as the specimen indicates (Fig 356 E) There was not much loss of blood In some of our other cases where parasitic attachments had developed, electrosurgery was of help in controlling hemorrhage The tumor however had to be removed piecemeal, in spite of extensive loss of blood In our last case 2500 cc of wl ood were given the patient intraven n the operating table f t e removed, so much the better If no ing areas are treated by the dire of radium The wound is pack cision closed

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RADIATION THERAPY

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Radiation therapy should con externally combined with direct radium within the nasopharynx tion of radon seeds into the tur and fast rules or definite plan of be laid down for every case It is at the outset rather mild radiati should be focused at the main tumor If the tumor is confined pharynx and nasal cavities, treat through the cheek or nose from through appropriate sized porta this, implantation of radon seeds

particularly near its attachments to cut off blood supply may be required

A word of warning Excessive radiation for such a benign tumor should not be given One of our patients referred by T O Rourke, a boy of sixteen whom we treated about twelve or fifteen years ago did receive heavy radiation intratumorally with radium element needles. Subsequently as the tumor sloughed out there was massive hemorrhage controlled by packing Ten years later the patient returned with signs of intracranial disease. He died a few hours after entering the hospital Unfortunately an autopsy was not obtained. However by careful postmortem examination through the nose, osteomyelitis of the base of the skull probably in the region of the cribriform plate was found Evidently this patient had late radio-osteonecrosis and secondary infection which extended into the cranium

It is also to be remembered that nasopharyngeal fibromas occur in growing individuals. Heavy radiation then might prevent normal growth of the surrounding bone, with late disfigurement We have not seen such a complication.

For interstitial radiation we usually use weak radon seeds, 2–3 mc. each carefully implanted within the tumor at a safe distance from bone. We have limited use of implants in recent years to small recurrences after operative removal For calculating doses for cases where radium is applied at operation, Quimby s Table for surface application is followed Five or six hundred milligram hours, scattered over the surface, would seem to be the maximum that should be given.

HORMONE THERAPY

Our experience with the use of hormone therapy has been limited to one patient a well developed, exceptionally tall boy who had a large nasopharyngeal fibroma, involving the nasopharynx left antrum and extending out into the cheek. The tumor had been irradiated before admission to the clinic. Because of continued growth a radical operative removal was done Subsequently there was recurrence Testosterone propionate, was given one hundred milligrams intramuscularly three times a week for a total dose of 3500 mg There was no regression of the tumor and the patient had severe hemorrhages almost to the point of exsanguination requiring ligation of both external carotid arteries He was re-operated through a Ferguson incision The growth had extended down behind the soft palate, was markedly adherent to the posterior pharyngeal wall, but had not re invaded the antrum As much of the growth was removed as possible and radium applied. It is too early to give a final report upon this boy but to date there has been no recurrence

Martin, et al., used testosterone propionate in ten cases and state, ' We had hoped at first to be able to control nasopharyngeal fibroma by endocrine therapy alone. This had not proved possible in the few instances in which its limited use has been employed. We have noted in these instances a definite and gradual elimination of the hemorrhagic tendencies of the tumors associated with an acceleration of the sexual maturity " It would seem to us that this form of therapy should be studied more completely as it apparently has beneficial possibilities

NEURILEMMOMA OF THE PHARYNX

Koop, et al. (1947) reported five cases of neurilemmoma of the pharynx, bringing the total number in the literature to eleven. These tumors theoretically arise in any portion of the body where a nerve sheath exists The pharynx is one of the rare sites. The exact point of origin is not definitely known in each case, but it is quite possible that several arose in deep nerves of the neck and in growing expanded under the pharyngeal mucosa. Neurilemmoma have been reported to have origin in the cervical sympathetics, roots of spinal nerves, trunks of the cervical plexus and in the spinal accessory and vagus nerves (see Chapt. XVII)

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The main points in postoperative care are to combat infection by antibiotics and watch for hemorrhage. The packs are removed in from five to seven days. The patients are kept under observation for an indefinite period and subsequent local application of radium or x ray therapy externally are given as indicated.

RADIATION THERAPY

In none of our cases has radiation therapy alone sufficed to completely eradicate nasopharyngeal fibroma Crowe and Baylor (1923) reporting four cases used a combination of radiation therapy and partial surgical removal. Some authorities suggest repeated small doses of radiation sufficient to control hemorrhage and keep down the growth of the tumor until the child has become sexually mature, when it is assumed that the growth will regress (Cutler and Buschke, 1938 Ackerman and Regato 1947) Martin et al., in twenty nine patients, used radiation, either x ray, interstitial radon, or a combination, in thirteen cases, seven of which also received hormone therapy Most of the patients on whom we have operated have not improved under radiation therapy It would seem then, from the literature and our own experience that radiation therapy alone is not sufficient but should be combined with surgery or hormone therapy or both as indicated by the progress of the tumor

Radiation therapy should consist of x ray externally combined with direct application of radium within the nasopharynx or implantation of radon seeds into the tumor No hard and fast rules or definite plan of treatment can be laid down for every case It is suggested that at the outset rather mild radiation with x ray should be focused at the main body of the tumor If the tumor is confined to the nasopharynx and nasal cavities, treatment is given through the cheek or nose from various angles through appropriate sized portals. Following this implantation of radon seeds in the tumor

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The symptoms in the reported five cases were referable to the pharynx and all patients had visible tumors in the pharynx. All were benign

growths. The final diagnosis is made only by histological examination. The authors do not recommend biopsy because of the danger of infection especially hazardous when an extra oral operation may be necessary to remove the neoplasm

Treatment is surgical removal either endorally or from a lateral cervical approach, depending on the size and location of the tumor One of the cases was treated primarily by irradiation and the authors concluded from the result that these growths are radioresistant. There was one postoperative death

We have had no experience with the diagnosis or treatment of neurilemmoma of the pharynx.

TUMORS OF THE HYPOPHARYNX AND BASE OF THE TONGUE

Malignant tumors of the hypopharynx and base of the tongue histologically resemble each other so much and their clinical features and response to radiation are so similar that it seems advisable to discuss them together As has been pointed out in Chapter II on embryology and Chapter IX on carcinoma of the tongue the epithelium of the base of the tongue and the hypopharynx is derived from endoderm. It is not surprising therefore, that a high percentage of malignant tumors in this region are poorly or entirely undifferentiated, there being no tumors with much keratinization and pearly body formation Martin et al., (1940) report that 33 per cent of the cancers of the tongue occur in the base.

ANATOMY

The hypopharynx (or laryngopharynx) is the lower part of the pharynx and, roughly speaking that part below the level of the hyoid bone and separated from the oropharynx by the pharyngeal-epiglottic fold The pyriform sinus is a depression on each side of the entrance to the larynx between the aryteno-epiglottic fold and the arytenoid cartilage internally and a part of the great wing of the thyroid cartilage and the thyrohyoid membrane, externally This is a frequent site for quiet tumors which produce no symptoms until metastases have occurred in the adjacent cervical lymph nodes. The mucous membrane of the pharynx is smooth except for elevations of collections of lymphoid follicle Mucous glands are numerous in the nasopharynx and oropharynx, but scarce in the lower part.

Clinical Behavior

Since cancer of the hypopharynx and base of the tongue is not visible to the patient, and does not cause local symptoms early most patients seek treatment late in the course of the disease. Pain is almost always a late symptom bleeding is not early but occasionally draws attention of the patient to his illness. Rarely pain is early when the growth is deep beneath the mucosa, especially in the base of the tongue. In these cases visual examination with the throat mirror early in the disease may reveal no pathology A submucous lump is discovered by digital examination.

The most common first symptom of carcinoma of the hypopharynx and base of the tongue is a lump in the neck. Particularly is his true of carcinoma in the pyriform sinus. Growths in this region attain considerable size without symptoms. Also small growths produce early and sometimes large metastatic masses in a closely related lymph node in the neck opposite the hyoid bone.

Examination usually reveals an ulcerated growth of varying size on the base of the tongue, in the pyriform sinus, or the lateral or posterior walls of the hypopharynx. Observation is made only with a throat mirror (see Chapter I) or by direct laryngoscopy At times the growth extends up over the epiglottis which may be curled and distorted out of shape. When the epiglottis and pyriform sinus are involved, cough and hoarseness may be symptoms which bring the patient to the physician. Palpation with a gloved finger is essential to obtain an adequate impression of the extent of the neoplasm Fixation of tissue and submucous extension not visible to the naked eye, are readily detected by direct palpation. Extension

of the growth out through the pharyngeal wall or deep into the base of the tongue can be elicited only in this way

Diagnosis

Final diagnosis is by biopsy With a rongeur forceps, curved properly, one can take tissue from the edge of the growth for microscopic examination Direct laryngoscopy may be required for adequate inspection and biopsy

Metastases

Metastases to the local lymph nodes occur early in cases of cancer of the hypopharynx and base of the tongue. Martin Munster and Sugarbaker report that 30 per cent of the cases of the posterior third of the tongue were not discovered by the referring physician, but were referred because of cervical adenopathy Our experience is similar They also found that 39 per cent had metastases on admission 24 per cent subsequently developed metastases, making a total of 63 per cent metastases sometime during the course of the disease

Wookey reporting on seventy autopsies of cases of cancer of the hypopharynx and esophagus from the Toronto General Hospital, states that 22 per cent showed no metastases, 16 per cent showed regional lymph node involvement and 38 per cent extension into the adjacent structures. Twenty-four per cent showed widespread metastases. *In cases where the cancer* was in the hypopharynx or in the upper end of the esophagus autopsy did not show widespread metastases, but widespread metastases were most commonly present in those cases where the lower esophagus was involved. Because of the large number which showed no metastases of regional lymph node involvement Wookey has devised an extensive operation for treatment The most common sites for local metastases are the lymph nodes adjacent to the pharyngeal wall, and base of the tongue, i e the deep cervical nodes below the angle of the jaw and the nodes along the carotid chain opposite the hypopharynx As the growth extends more metastases occur Any therapy therefore must be directed at the lymph nodes, draining the hypopharynx which lie along the carotid sheath

Treatment

As a high percentage of cases of cancer of the hypopharynx and base of the tongue come in late stages with metastases, the majority of cases are best treated with radiation therapy

RADIATION THERAPY TO POSTERIOR THIRD OF TONGUE AND HYPOPHARYNX

Many technics have been described for the radiation of tumors in the base of the tongue and hypopharynx. These various technics have enough similarity that the description of our own will suffice as an example Tumors in this region are quite anaplastic and radiosensitive. Operatively they are difficult to remove. Many of them also involve the epiglottis and in some it is difficult to state whether the tumors began on the epiglottis and extended into the vallecula and the base of the tongue or began on the tongue and extended to the epiglottis. Many of them are infected when first seen. Also many are not recognized until a cervical lymph node becomes enlarged as there are few local symptoms of this disease until the growth has become extensive

We usually begin with external irradiation through each side of the neck focusing on the posterior mouth region and hypopharynx, using a 6 x 8 portal and the following factors 200 Kv., 15 Ma. T.S D 50 Cm., ½ mm. Cu and 1 mm Pl filter 200 r are given on each side, three times a week until a total of 2000 or 2500 r have been delivered on each side Such treatment reduces infection and starts the tumor on its regressive course and at the same time tests its radio-sensitivity Regression of the neoplasm is indicative that further intratumoral irradiation will be of value If there is little response then intratumoral irradiation will be outweighed by the severity of the reaction and *should not be given*

Intratumoral radiation with radon seeds or radium element needles, chiefly of value in

base of tongue cancer then follows with the aim of bringing the intratumoral dose (including that from x ray therapy) up to at least 8000 gamma roentgens. Radon seeds are implanted in this rather inaccessible place, as follows

General anesthesia with pentothal sodium is preferable to local anesthesia When the patient is asleep an intranasal tube is inserted into the hypopharynx and the pharynx packed off The operation is of short duration and intratracheal anesthesia is not necessary Oxygen and sometimes nitrous-oxide mixed with it is given through the hypopharyngeal tube. With one finger in the mouth behind the tongue as a guide, the radon seed implanters are thrust through the floor of the mouth and into the base of the growth as shown in Figure 260 This allows the application of the seeds without going through the infected ulcer Implantation through a dirty ulcer often carries infections into the deep tissues, increasing the amount of reaction following the implantation. *The seeds are first implanted around the edge* of the tumor in the normal tissues and then distributed evenly throughout the growth at 1–1.5 cm. distance from one another giving uniform distribution. Many large tumors greatly regress by this technic, and a few heal.

Pridie (1930) quoted by Spencer and Cade described a method of insertion of radon seeds through the skin in the submaxillary region Spencer and Cade (1931) reported a method of lateral pharyngotomy for implantation of radon seeds into the base of the tongue and vallecula. Preliminary tracheostomy is the rule. An incision is made along the anterior border of the sternomastoid muscle and the tumor approached through a transhyoid pharyngotomy for the same purpose We have had no experience with this approach to the base of the tongue for the implantation of radium element needles or radon seeds

SURGICAL TREATMENT

Until recent years, with the improvement in surgical technic and supportive measures to the patient surgery was thought to have but a limited place in the treatment of cancer of the hypopharynx and base of the tongue. From time to time, various operations have been devised permitting resection of the base of the tongue, either through a unilateral incision in the side of the neck, or through a curved incision beneath the mandible, approaching the base of the tongue from the front.

Harold Wookey, of Toronto (1948) has described a surgical procedure for the removal of the hypopharynx esophagus, trachea, and larynx, if necessary for cancers of the hypopharynx and base of the tongue We have operated on two patients following his method one with good results. Since the operation is new and our experience with it is limited we quote freely from his article with Wookey's permission. Wookey divides the cases of cancer of the hypopharynx into two convenient categories.

1 Lesions occurring in the pyriform fossa or anterior wall of the pharynx involving the back of the larynx Naturally any operative *procedure in these patients will require the* loss of the larynx However provided the pharynx and esophagus can be properly reconstructed so that eating will be a pleasure and not a difficulty the loss of the larynx is of little importance, as compared to saving life.

Figure 358 illustrates a large flap of skin which is resected from the neck to expose the lymph node-bearing area on each side of the esophagus and larynx. The flap is based on the side of the disease and is provided with a wide base The flap includes the subcutaneous fat and platysma muscle. The lower half of the sternomastoid muscle is removed but the upper half is preserved for important blood supply to the skin The isthmus of the thyroid is isolated and divided and separated from the trachea (see Fig 358) The lobe of the thyroid on the side of the operation is removed The trachea is now divided immediately below the cricoid cartilage, separated from the esophagus behind and into the distal end of the trachea is passed a rubber tube for anesthesia The larynx and pharynx are separated from the prevertebral fascia as high as the hyoid bone and a transverse opening made into the

larynx below the epiglottis for direct view of the interior of the pharynx. One can thereby estimate the correct level for dividing the pharynx above. We have found this a point of great importance in determining the exact size of the growth (Fig 359) One of our cases which appeared operable on preoperative examination was found to have extensive invasion of the base of the tongue and pharyngeal wall and should not have been operated upon It seems to us that the inspection of the pharynx might be done to advantage early in



Fig 357 Illustrates extensive carcinoma of hypopharynx involving the larynx. The larynx and the hypopharynx are removed *en bloc* as described in the text.

the operation and, if the condition is found inoperable, the removal of the thyroid and the cutting across of the trachea could be spared.

The esophagus is now isolated behind the trachea and as much preserved as possible at the same time giving a wide margin to the growth The esophagus is now divided and the entire block of tissue made up of the hypopharynx and larynx, together with surrounding lymph nodes on both sides, is removed Bleeding points are either ligated or controlled with clamp coagulation.

The reconstruction phase of the operation is now begun A flap of skin is brought across the middle line, so as to lie on the prevertebral

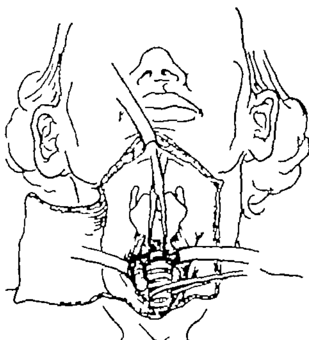


Fig 358. Large skin flap reflected isthmus of thyroid divided trachea exposed, and position in which it is divided



Fig. 359 Intratracheal tube in position Pharynx divided below hyoid. Oesophagus mobilized ready for division

fascia and sutured by two longitudinally arranged lines of interrupted fine catgut sutures. The upper border of the flap is sutured to the posterior margin of the upper pharynx (Fig

360) Similarly the cut end of the esophagus is sutured to the lower edge of the skin flap



Fig 360. Illustrates method of using skin flap for reconstruction of pharynx, sutures being placed above and oesophagus ready for suture to lower margin of skin flap

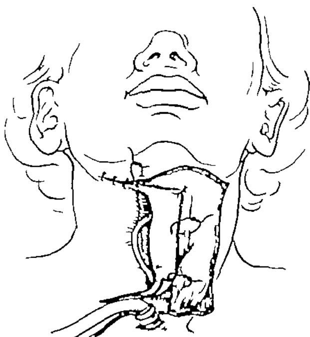
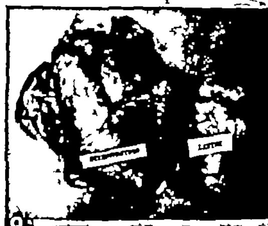


Fig 361 First stage of reconstruction completed showing line of oesophagus sutured below upper suture line to pharynx now concealed, remainder of skin flap being used to close raw surface as far as possible before Thiersch grafts applied

After removing a part of the margin of the skin flap below to increase the surface of skin sutured to the esophagus, the rest of the wound is covered as far as possible by the skin flap





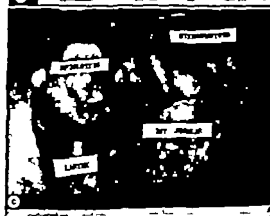


Fig. 362 Wookey operation for carcinoma of base of tongue

A Operative field after removal of specimen and before closure. Note that in this case it was possible to leave the posterior wall of the esophagus (x) which allowed reconstruction of the esophagus The skin flap then covered the wound

B Anterior view of surgical specimen

C Posterior view of surgical specimen

(Fig 361) A duodenal tube is passed down the esophagus into the stomach and its upper end brought out through the nose The tube lies on

the skin flap and indicates the line of the reconstructed pharynx and esophagus Any remaining raw surfaces are covered with split thickness grafts. The upper end of the trachea is sutured to the skin above the sternum in such a manner that the trachea projects about ¼ inch above the surface. A large tracheostomy tube is then inserted into the trachea and secured.

Usual careful nursing and postoperative care is essential. After about three or four days, the patient is fed through the duodenal tube.

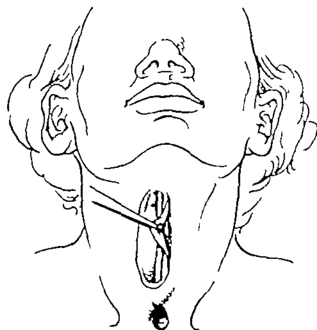


Fig. 363 Method of closing longitudinal fissure by incising and undercutting the skin.

After about five weeks, allowing for the establishment of collateral circulation the longitudinal sulcus in the neck is closed (Fig 363 and 364) An adequate tube of skin has replaced the pharynx and upper esophagus. The raw surfaces are covered with split thickness grafts. The duodenal tube is left in for about three weeks longer Then the patient is allowed to take food by mouth

2. The second type of case in which the lesion is confined to the retrocricoid area (Fig 365 upper circle) and does not involve the larynx or its immediate surroundings permits the operation to be modified and the larynx preserved. Anesthesia is administered through an intratracheal tube passed through the nose or mouth A similar flap of skin is fashioned as

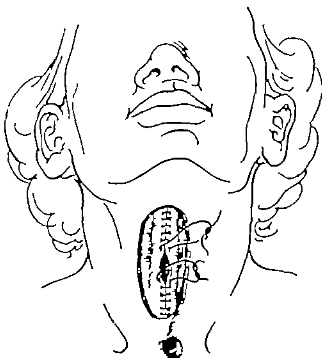


Fig. 364 Shows margins of skin tube being sutured

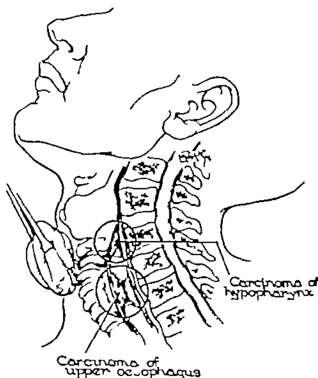


Fig. 365 Diagram illustrating a retrocricoid carcinoma of the pharynx (top circle) In lower circle, a carcinoma of the upper end of the oesophagus. Both types described in the text.

previously described. The lobe of the thyroid on the side of the operation is mobilized and

pulled over rotating the pharynx and larynx towards the opposite side, so that the pharynx is approached on the inner side of the carotid sheath The anterior belly of the omohyoid muscle is removed The upper end of the esophagus and as much of the hypopharynx is resected as indicated to give a wide margin to the tumor The flap of skin is brought across the midline so as to lie on the prevertebral fascia and secured by a series of interrupted catgut sutures (Fig 366) The lobe of the *thyroid gland which has been freed is* removed

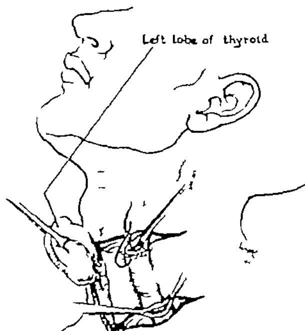


Fig. 366. Illustrates method of reconstruction of lower pharynx and upper oesophagus in cases of retro-*cricoid and upper oesophageal carcinomata. The larynx* has been preserved. Lobe of thyroid retracted.

and the remainder of the skin flap is brought around in front of the larynx and trachea as far to the opposite side as its *length will* permit and sutured Any raw surfaces are covered with split thickness graft A duodenal tube is passed down the esophagus and upper end is *brought out through the nose* Tracheostomy should be done at this point for postoperative edema may require an emergency tracheostomy later

After five or six weeks, the deep lateral fissure in the neck is closed leaving a buried tube of skin replacing the pharynx and esophagus which have been excised

Prognosis

The outlook for the patient with cancer of the hypopharynx and base of the tongue *is not* good Influencing prognosis perhaps as much as anything else is the fact that patients with these lesions are not seen in the early stages and a *high* percentage come after lymph node involvement has occurred and many times is extensive A second factor influencing prognosis is the inaccessibility of the lesion for the application of x ray or radium and for surgical removal

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Chapter XIII

TUMORS OF THE PARANASAL SINUSES AND NASAL MUCOUS MEMBRANE

Collaborator John A. Kirchner, M. D *

In this chapter, tumors of the paranasal sinuses and nasal mucosa will be considered together because the linings of these cavities are similar and symptomatically it is difficult ofttimes to determine whether the neoplasm began in the nasal passages or in the ethmoid sinuses or antrum and grew into the nose secondarily Since carcinoma of the antrum is the most frequent type of growth in this region it will be discussed first Ordinary benign edematous polyps of the nasal cavities and sinuses will not be included except by reference occasionally from the standpoint of differential diagnosis.

CARCINOMA OF THE ANTRUM

Anatomy

The maxillary sinus, or antrum of Highmore is a roughly pyramidal-shaped cavity in the body of the maxilla, the apex presenting in the zygomatic process, and the base corresponding to the lateral wall of the nose The walls of the antrum become thinner as age progresses, being very thick in infancy and extremely thin in old age.

The antrum presents, in general, five surfaces (1) medial, or nasal, (2) superior or roof (3) anterior (4) posterior or infratemporal (5) inferior or floor the alveolar process. A thin mucous membrane continuous with the nasal mucosa via the *maxillary ostium* lines the cavity

The base, formed by the nasoantral wall is the thinnest of the walls and through it the antrum communicates with the nasal cavity by means of the maxillary ostium, an oval or elongated aperture opening into the ethmoidal infundibulum. There is sometimes an accessory ostium which opens directly into the middle nasal meatus.

The anterior wall is thin at the canine fossa and is traversed by the infraorbital vessels and nerves

The superior wall, or roof forms the floor of the orbit It is crossed by the infraorbital groove, carrying the infraorbital vessels and nerves the anterior and middle superior alveolar vessels and nerves to the incisor, canine, and premolar teeth.

The posterior wall corresponds to the infratemporal surface of the maxilla and is separated from the anterior surface by a strong ridge running upward from the first molar tooth This surface is pierced near the center by the canals for transmission of the posterior superior alveolar vessels and nerves A groove for the maxillary nerve runs upward on the posterior wall and joins the infraorbital groove on the posterior margin of the orbital surface of the antrum.

The inferior surface is very uneven because of prominences corresponding to the roots of the molar teeth Usually there is a thin bone separating the roots from the antral cavity and sometimes the roots project into the cavity The 1st and 2d molar teeth are in closest relationship with the sinus but the sockets of any of the teeth in the maxilla may under disease conditions communicate with it

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Incidence

Cancer arises in the maxillary antrum more frequently than in any of the other paranasal sinuses in the proportion of about 5-1 It affects men about four times as often as women Most antral cancers develop between the ages of fifty five and seventy

Histology

The majority of malignant tumors of the antrum are squamous cell carcinomas arising from the mucous membrane lining the sinus. Papillary forms of squamous cell carcinoma may occur Basal cell carcinomas, in our experience are seldom seen in the antrum one of our cases occurred in a boy of fifteen years (*Fig 367*) *According to Ewing* (*1928*) cylindrical cell carcinoma (adenocarcinoma) is common in the antrum. New (1935) reported ninety-one primary tumors of the antrum sixty three were classed as squamous cell epithelioma, six as adenocarcinoma, seven as round cell sarcoma, nine as fibrosarcoma and osteosarcoma, and the others as myxosarcoma (1) lymphosarcoma (3) and malignant, type of cell not determined (2) Ewing held that the so-called *round cell carcinoma* is often mistaken for sarcoma.

In our experience primary sarcoma of the antrum is extremely rare Melanoma occurred in a colored woman The primary site was difficult to determine as the growth filled the right naris and antrum and invaded the mouth.

Dental tumors may invade the antrum (see Chapter X, Tumors of the Jaws)

Clinical Behavior

Most patients present themselves for diagnosis and treatment fairly early after onset of symptoms, usually within three months On the other hand, many neoplasms are far advanced before producing symptoms, a factor reducing the prognosis. The usual presenting complaint is pain commonly over the antrum, and sometimes described by the patient as under the eye over the side of the face in the cheekbone Less often pain begins in the upper teeth on one side and still less often the initial symptom is pain in the eye. Pain beginning in the upper teeth and persisting after extraction of the teeth is a fairly common presenting complaint

The next most frequent initial complaint is swelling over the antrum (Fig 367 A-D) This symptom often occurs as a secondary or later development in the course of the disease Swelling in the roof of the mouth and protrusion of the eye are less commonly encountered as initial complaints, but indicate extensive disease Swelling of the nostril, side of the nasal ala or alveolar ridge usually occurs as a late manifestation after destruction of the bony walls.

Next in order of frequency is nasal obstruction, often encountered as an initial symptom and frequently as a second or later symptom. Nasal discharge is at times a presenting complaint and a common later development Bleeding from the nose occurs next in frequency as an initial complaint and often develops shortly after the onset of obstruction or discharge

Following the extraction of upper teeth, a persistent discharge or protrusion of neoplastic tissue from the tooth socket betrays the presence *of cancer in the antrum*

Trismus was the presenting symptom in two of our cases and is due to invasion of the pterygoid fossa. One patient complained initially of a "hole in the cheek.' Lacrimation is occasionally an early complaint and is due to obstruction of nasolacrimal duct

Late symptoms include pain in the antrum upper teeth, or eye, frequently described as "lightning' or "shooting pains " numbness and paresthesias over the 2d division of the 5th nerve Headache frontal occipital, or hemicrania is usually a late symptom. Protrusion of the eye is a common late development in those cases which are not treated or fail to respond to therapy and is usually accompanied by diplopia Nasal discharge and bleeding are often late complications of the disease

As the growth proceeds posteriorly toward



Fig. 367

A. Basal cell carcinoma of the superior maxilla in a boy fifteen. Symptoms began 6 months previously with a painless swelling of the left cheek. Treated as an infection by plasters and extraction of the first upper left molar tooth. This was followed by brisk bleeding for an hour. Patient gave a history of being struck by the handle of a pick-ax about a year previous to the onset of the symptoms.

B. Roentgenogram showing destruction of the lateral wall and floor of the antrum and much new bone formation. At operation the floor of the antrum was found to be greatly thickened because of new bone production. The antral floor was about a centimeter thick.

C. Photomicrograph showing basal cell carcinoma more or less in papillary formation.

D. High power photomicrograph showing invasion of bone by growth. There is new bone production.

the nasopharynx earache tinnitus, and blocked ear may develop. Two of our cases stated that the disease followed local injury.

PHYSICAL FINDINGS

The most common finding on the first examination is the presence of a vascular 'meaty'

tumor in the nasal cavity on one side which bled easily on being touched. It is usually associated with foul smelling pus from surface necrosis of the cancer, resulting from the rapid growth outstripping its blood supply The neoplasm is often large enough to occlude a nasal chamber and sometimes the opposite side by displacement of the septum In one of our cases the external nose was deflected to the



Fig. 368 Squamous cell carcinoma right maxilla and palatine bone secondary to carcinoma of the antrum.

opposite side by the growth Transillumination reveals a dark antrum and sometimes a dark frontal sinus, resulting from obstruction of the nasopharyngeal duct. In only one case was there growth in both sides of the nose this was an advanced case associated with proptosis and fixation of both eyes.

Swelling over the antrum is the next most common finding and may be associated with tenderness over the canine fossa There is destruction of the anterior bony wall and a palpable mass in the cheek often accompanied by bulging of the alveolar process A tumor mass may be visible above and lateral to the upper teeth with or without an opening into the canine fossa and a purulent discharge

The orbit may be involved early in the disease so that proptosis or palpable destruction of the inferior rim is present on initial exa tion. Diplopia and ptosis are later com tions.

The floor of the antrum is invaded n order of frequency with bulging or ulce of the hard palate (Fig 368)

Metastases

Malignant tumors of the antrum metas rather late through the lymphatics. The phatics of the superior maxilla pass poste to join with those from the nasal m membrane and vault of the pharynx ar scend along the deep cervical chain Th node to be involved usually is the deep su cervical node back of the angle of th (Fig 374)

Treatment

Treatment of cancer of the antrum re both surgery and irradiation the term s includes scalpel and electrosurgical tec and the term *irradiation* includes x ra radium therapy The thorough manag of this disease then becomes rather plicated and he who would undertake t trol cancer of the antrum must be well of the clinical value of both surgery and ir tion

Cancer of the antrum is frequently f vanced before the patient is aware o condition or before he comes to the spe equipped for management of his case T fore many antral cancers have penetrate or more of the walls and invaded impo neighboring structures, adding to the se ness of the prognosis and to the diffic of treatment Also, infection is commo quiring adequate drainage to prevent dam up of pus associated with high fever sepsis, particularly during the post rad period

Before any treatment is started, the nosis must be assured by histological stu tissue removed through the nose or throu opening into the antrum from the mout attempt should be made to localize th of origin of the cancer and the amount of

involvement and extension to neighboring structures. This is obviously not always easy nor possible, but careful roentgenographs will often give a fair idea of the extent of invasion of the malar bone and lateral wall, or the nasal wall or floor so that irradiation and surgery may be more accurately utilized.

The absence of exophthalmos and the presence of a good orbital floor evidenced by roentgenograph are strongly suggestive of lack of invasion of the orbit possibly permitting the saving of the eye The presence of exophthalmos and/or swelling of the lower eyelid, on the other hand, should lead the clinician to warn the patient that loss of the eye may be inevitable

Perforation of the anterior wall may be determined by palpation of the cheek or by roentgenograph or in more advanced cases by swelling of the cheek dilation of skin veins redness, edema and fixation of the skin or even direct extension through the skin.

Invasion of the nasopharynx may or may not be determined by examination with a throat mirror or nasopharyngoscope It may be suspected by bleeding from the nose or mouth or by pain in the cheek or head Pain and clouding of the ethmoid sinuses in the roentgenograph may mean ethmoid involvement by growth or dammed up infection.

Pterygoid fossa involvement is not always detectable prior to operation Suspicious signs are swelling of the lateral part of the face and temple localized pain and trismus.

Not uncommonly softening or swelling of the palate or antral floor or frank ulceration in the mouth will be evidence of downward extension of the disease

IRRADIATION THERAPY

Irradiation therapy has taken a very prominent place in the management of cancer of the antrum during the last twenty five years However the enthusiasm which accompanied its advent into this field has gradually waned as the expected good results have not always materialized Some cancers of the antrum have been reported cured by irradiation therapy We have one case in which there is histological proof of the presence of cancer of the antrum before radiation therapy and a careful search of all the tissue removed later at operation revealed no growth This is unusual. With the run-of the-mill cases, it is impossible to determine whether the cancer has been completely eradicated by irradiation until months or years have elapsed, and false hopes based on temporary regression of the tumor are dashed to pieces because of quiet and continued extension into the orbit, pterygoid fossa nasopharynx, malar bone, or base of the skull, rendering further benefit impossible. There is no sure method of watching the progress or regression of antral cancer following irradiation even through a permanent opening from the mouth into the antrum. Unless the primary lesion is small and can be treated adequately both with x ray from the outside and with radium applied directly, all cases should have a radical resection of the superior maxilla following irradiation With this in view, our usual routine technic for irradiation treatment of cancer of the antrum is given

X-ray Therapy After the diagnosis has been established by histological study and the approximate extent of the disease determined by clinical and roentgenographic examinations, a course of roentgen therapy is begun. Two or three ports, 4 x 5 or 5 x 6 cm. in size, are chosen over the affected side one anterior and one lateral and directed towards the base of the disease, if determinable Occasionally a third oblique port (3 x 4 cm.) is used between the anterior and lateral ones When there is evidence of ethmoid or orbital involvement, a fourth port is directed through the zygoma and just above the lateral port We have not always used a port from the opposite side. Some authors emphasize the value of the added radiation coming through the opposite cheek. In extensive cases where the orbit is involved a fifth port straight through the orbit from the front is employed The patient is warned of possible destruction of the eye but the value of the treatment outweighs this loss

The treatment factors are 200 Kv 15 Ma

50 cm T S D ½ mm Cu 1 mm Al filtration total dosage from 2400–3000 r per port Treatments are given in doses of 300 r through each of two ports per day three times a week An additional port is added when the palate is involved, the beam of rays being directed through the palate using an intraoral cone. The treatment factors are the same, except the T S.D is 35 cm. The total tumor dose is taken up to about 7000 r measured in air, including the intraoral port.

A well developed epithelitis follows with *desquamation and sometimes blistering* In from four to six weeks, the skin is sufficiently healed to make primary union after operation relatively safe.

Radium Treatment. In the past we have employed various methods of radium application, including the implantation of radium element needles the insertion of radium tubes into the antrum and into the nose to cross-fire upon the disease. Experience has taught that radium application by and large, is best used at operation However if the primary site can be determined preoperatively and is found to be on the naso-antral septum or the floor of the antrum and the growth is localized to these accessible regions, radium tubes may be applied *through an opening made in the floor of* the antrum and through the nose before or after the course of roentgen therapy A small *protective lead shield is inserted in the nostril* against the septum The total dosage of radium applied in the antrum is usually 1000–1500 mg hr., filtered with 1 mm Pt. the average being approximately 1200 mg hr

In the more extensive cases which have had preoperative x ray therapy radium is applied during the radical operation The cancer is as completely removed as possible and the radium laid against those areas of lingering tumor whether in bone or soft tissue We determine the dosage according to Quimby's Tables and give approximately 6000–8000 gamma roentgens at one sitting calculated at a centimeter depth in the tissue

The radium tubes in a rubber cot are laid directly against the involved area and held in place by a firm gauze pack, inserted at the end of the operation In this way the ethmoid sinuses the pterygoid region and any other areas infiltrated by the growth are treated Such direct applications produce subsequent sloughing and radio-osteonecrosis. Many of these patients suffer a great deal of pain but the severity of the treatment is justified by the end result. Careful postoperative attention is necessary for weeks and months. Pieces of slough and sequestra must be removed from time to time and the patient is instructed to irrigate the antrum with warm normal salt solution frequently to keep down infection and reduce pain

SURGERY

The conservative surgical approach is through the floor of the antrum in the upper bucco-gingival sulcus. The opening is enlarged as necessary to expose the entire antrum allowing curettage and removal of its contents. Many times cancer is found unexpectedly when this so-called *radical operation* is done for infection or polyps. Such accidental findings also require opening into the nose—the Caldwell-Luc operation

The Caldwell Luc operation consists of opening the antrum through the canine fossa cleaning it out, and then making a counter-opening through the antro-nasal septum for drainage and subsequent treatment The original opening in the canine fossa is then closed Subsequently it is possible to pass radium tubes through the nose and into the antrum via the opening left by the operation Some early cancers can be handled by irradiation in this fashion. When cancer is found it is preferable not to close the mouth opening but to cause a permanent *sinus to develop for inspection from* time to time and for insertion of radium tubes into the antrum as necessary This internal irradiation with radium should be coupled with x ray therapy following the technic as described previously

RESECTION OF THE SUPERIOR MAXILLA FOR CARCINOMA OF THE ANTRUM AND UPPER JAW

Since the exact location and site of origin of the cancer is not always directly attainable by clinical and x ray studies, we aver that the best surgical approach in most cases is through the cheek for adequate exposure of the entire superior maxilla. When the antrum is entered through such a wide incision all walls are readily explored and penetration of the growth into the surrounding structures can be followed namely into the nose, nasopharynx ethmoid and sphenoid sinuses, orbit, or pterygoid fossa. The growth is destroyed by electrosurgery curetted away, and redestroyed, even though one cannot resect it as would be desirable Any disease that cannot be completely removed or destroyed with the heat of electrosurgical current is destroyed with the direct application of radium not possible with any other approach

Anesthesia Our present routine is as follows

Induction is begun with pentothal sodium intravenously and usually continued throughout the operation the maximum safe dose being 2 gm After the patient is asleep an intratracheal tube is passed through the nostril on the opposite side from the operation Some anesthetists prefer to spray the throat and nose with local anesthetic solution to control the gag reflexes prior to passing the intratracheal tube Inhalation anesthesia of oxygen and nitrous-oxide is then begun and continued throughout the operation At no time must either be employed if the electrosurgical current is to be used on account of the danger of explosion. By this combination of pentothal sodium and nitrous-oxide and oxygen anesthesia may be continued for two to four hours without ill effects upon the patient.

Position of the patient. The patient is placed on the back with the head of the table lowered and the neck slightly extended, facilitating drainage of blood and secretions from the respiratory tree The surgeon may stand at the head of the table or on the side of operation

Ligation of the external carotid artery and its branches in the neck at the beginning of the operation has become routine to reduce bleeding during the operation and to prevent postoperative hemorrhage

Incision The classical Fergusson incision with scalpel is made as follows

Beginning at the vermilion border of the upper lip in the midline, the incision is carried up to just beneath the columella of the nose, then around the ala of the affected side and up along the border of the nose to 1 cm below

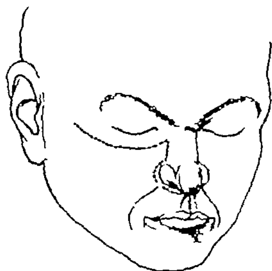


Fig. 369 Diagram showing Fergusson incision used to reflect the cheek and resect the superior maxilla.

the inner canthus of the eye (Fig 369) By experience, we have found better healing in this region if the incision is continued around under the inner canthus in a curved manner, with the convexity upward avoiding a small point of skin at this site. The incision is then carried laterally just below the border of the orbit in a curved line with the concavity upward following the contour of the orbital ridge to the malar bone and then across toward the ear just above the zygoma If previous x ray study has shown much involvement of the malar bone or zygoma, the incision is carried out to the ear and then down to about the lobe of the ear, in order to permit a larger flap of cheek to be turned down for exposure of the entire zygoma and the tissues beneath it The incision is carried completely through

the lip and cheek down to bone throughout its length except in front of the ear Here the incision goes through the skin and subcutaneous *fat, but does not enter the parotid gland.* By passing close to the upper border of the zygomatic arch the infraorbital branch of the facial nerve will be missed which, if injured, would paralyze the lower portion of the orbicularis muscle. Accidental injury to the fibers of the malar branch causes no serious deformity Also the temporal branch which passes upward hemorrhage by using a strong electrosurgical cutting current in dissecting away the soft tissues of the cheek from the maxilla. When *the reflection of the* mucous membrane from the superior alveolus is reached the scalpel is again used to incise the mucosa along the buccogingival fold All the soft tissues then have been removed back to the masseter muscle

The mouth is then opened more widely and with electrosurgical cutting current an incision

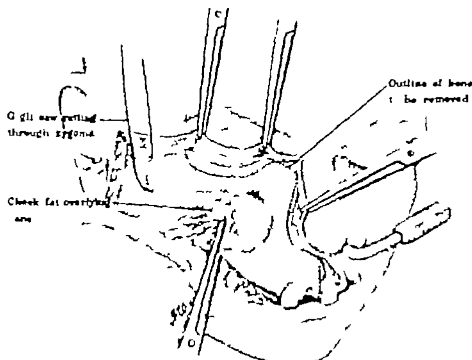


Fig 370 Operation for resection of superior maxilla, cheek flap turned back showing growth perforating anterior antral wall and involving subcutaneous fat Note lines of bone incisions through the midline of the upper jaw to the floor of the nose across the nasal bone and through the zygomatic arch and lateral antral wall.

and forward in front of the ear to supply the frontalis muscle and upper part of the orbicu*laris palpebrum should not be injured which* will give a paralyzed forehead with undesirable disfigurement.

The soft tissues of the cheek are then reflected off the maxilla Should the growth have penetrated the anterior antral wall as indicated in Figure 370 care should be exercised not to cut into it but rather leave a safe margin of fat attached Involved skin, too should be left with the growth to be taken away when the maxilla is removed Secondary repair will then be necessary It is advantageous to limit is made down the midline of the palate after extraction of the central incisor tooth on the *side to be removed This palatal* incision is made down to the bone and carried straight back to the edge of the hard palate From the posterior end of the palatine incision a right angle incision is made across the posterior edge of the hard palate around and back of the superior alveolar tuberosity to meet the incision in the buccogingival fold

With hammer and chisel an incision is made through the midline of the palate to its posterior border Another incision is made at the junction of the superior maxilla with the nasal

bone, and a third when indicated at the lateral edge of the orbit just above the junction of the zygoma with the malar With a blunt instrument a tunnel is made beneath the zygomatic arch, between it and the temporal muscle A Gigli saw is passed through this tunnel and the zygoma cut across All of the main bone attachments of the upper jaw now having been severed, strong forceps wrench the maxilla from its location (Fig 371) Bleeding is temporarily controlled with gauze pack saturated with warm normal salt solution and gradually lifted away as the severed vessels one-by-one are either clamped and coagulated through the clamp or closed by a ball coagulator directly applied to them Electrosurgery plays a great part in the control of hemorrhage deep in the cavity left by the removal of the superior maxilla

When the orbital floor is not involved by the neoplasm it is left unmolested as support for the orbital contents and better cosmetic result.

Not uncommonly cancer of the antrum grows up into the ethmoid and sphenoid sinuses These are entered boldly with electrosurgery and cleaned out. Care is exercised to avoid perforation of the roof of the sphenoid sinus and opening the cranium. When growth has extended into the ethmoid and sphenoid sinuses, obviously there is a greater need of a postoperative course of penicillin than ordinarily

During the operation bleeding is to be expected from the branches of the external maxillary artery in the cheek the superior coronary artery of the lip the lateral nasal artery, and the angular artery below the inner canthus of the eye In the mouth hemorrhage is very well controlled by the strong electrosurgical cutting current used to make the incision down the midline of the palate. As the incision is carried across the posterior edge of the hard palate the only troublesome bleeding is from the descending palatine artery as it emerges from the posterior palatine canal Usually this vessel is controlled with the ball coagulator directly applied Deep in the wound after the superior maxilla has been resected bleeding occurs from branches of the internal maxillary

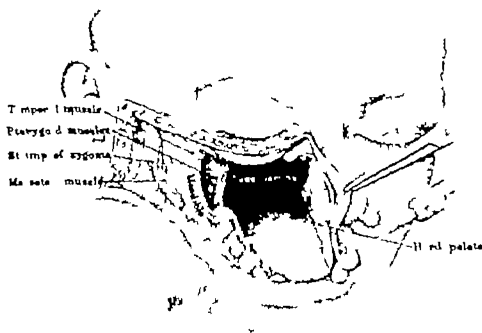


Fig. 371 Superior maxilla has been resected. Hemostasis secured

artery Some of these can be clamped and coagulated others must be coagulated by pressing the ball coagulator against them and then turning on the current Should the pterygoid fossa be opened, brisk bleeding may come from the internal maxillary artery and the pterygoid venous plexus Clamping and coagulation or ligatures suffice to control hemorrhage

After securing hemostasis throughout the wound a careful search is made for any residual

our technic of this operation and hasten period of convalescence and healing b transplantation of a split thickness skin to the undersurface of the cheek flap (Fig The graft is made sufficiently large to fol and cover any raw surfaces of the ma cavity Sometimes it will necessarily lir orbit if the orbital contents have been ev ated At other times the pterygoid muscl undersurface of the masseter muscle may

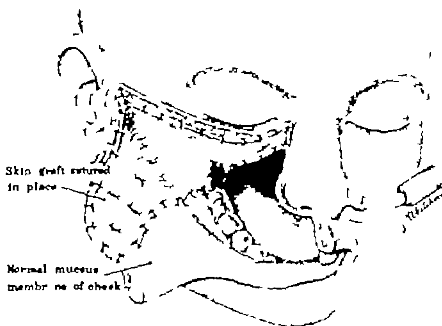


Fig 372. Split thickness graft sutured over all raw surfaces of the cheek masseter muscle and pterygoid Wound closed.

growth When found it is thoroughly coagulated and curetted away and re-coagulated If the residual growth is in muscle it is removed *with an electrosurgical curette* Irremovable remnants are destroyed with strong current on a ball coagulator These areas are then covered with radium tubes in rubber cots and the proper dosage calculated with the *idea of giving 6000–8000 gamma roentgens* at a centimeter depth To these radium tubes are attached long threads, brought out through the mouth and strapped to the skin at the end of operation The tubes are held in place by firmly packed iodoform gauze

Since February 1946 we have improved

to be covered with skin grafts We have le since that this technic is used at the Men Hospital N Y

The *graft is taken from* a suitable site with a dermatome and laid in the d to be covered. As it is sutured in place w chromic catgut on an atraumatic needle graft is trimmed to fit the raw surfaces. sutures are scattered throughout the gra obliterate any dead spaces beneath it. maxillary cavity is then packed firmly iodoform gauze and the cheek flap su back to its normal bed with interrupt chromic catgut as subcuticular sutures interrupted black silk sutures in the skir

insure against the patient's swallowing or aspirating any of the iodoform gauze, a black silk thread is sutured and tied to each piece and brought out through the mouth.

The floor of the orbit is removed with the superior maxilla when involved by growth. The loss of support of the orbital contents results in a drop of the eye and double vision. Scar tissue fixes the inferior rectus muscle at times, limiting motion of the eyeball. To prevent the drop of the ball, MacFee uses a flap of adjacent temporal muscle across beneath the orbital contents, as described by König. The application of a skin graft has been helpful in our hands.

MacFee also recommends supporting the eye by suturing the lids together after scarifying the borders. The lids then grow together. After the face wound is healed the lids may be reopened. Although we have practiced this procedure for other conditions, we have not used it in association with antral operations.

It is not necessary to apply a heavy dressing if one is assured that the packing is firm enough to hold the skin graft against the inner side of the cheek. We now cover the incision with a few layers of gauze saturated with dermatome cement. This is a solution of latex in ether and dries to form a good protecting covering for the incision.

Postoperative care. On returning to bed the patient is placed prone with the head on the well side, where he remains until awake and able to move around normally. The next day he is allowed to get out of bed, temperature permitting. The pack is not removed for five to seven days unless radium tubes have been inserted. Often the tubes can be removed by traction on their strings without disturbing the pack. At other times the pack must be replaced after the radium has been taken out. When the graft has taken well, the packs may be left out.

When a graft has not been applied and there



Fig. 373

A. Roentgenogram of extensive carcinoma of the left antrum which has destroyed the floor, the lateral wall and the base of the zygomatic arch. This patient also had considerable inflammatory reaction and swelling above the zygoma. Biopsy showed squamous cell carcinoma. Treatment consisted of x ray therapy through 4 external portals of 4 cm. each towards the left antrum as follows: Port 1—anterior—2800 r. Port 2—lateral—2100 r. Port 3—above zygoma—1800 r. Port 4—low anterior—2576 r. Treatment factors: 200 Kv. 15 Ma., 1 mm. Al + ½ mm. Cu filtration. T.S.D. 35 cm. Operation 6 weeks later, partial resection of superior maxilla with electrosurgery through a Fergusson incision. The antrum was found to be filled with scar tissue. Frozen section showed no carcinoma. Since the floor of the orbit was not involved it was left intact. The nasal wall, floor of the antrum and lateral walls were all removed as well as part of the zygomatic arch. Permanent pathological section showed no carcinoma. This is one of the very few cases that have been shown by histological examination to have had all the carcinoma eradicated by external x-ray therapy.

B. Photograph of patient after operation and after postoperative edema had subsided.

is coagulated tissue and slough to come away the packs are changed every three or four days. It is better to continue repacking for several weeks when granulation is developing in order to prevent the accumulation of dried mucous and serum forming large scabs which are harbingers of infection and a source of irritation. Most of our cases have had dental impressions taken prior to surgery and plans laid by the dental consultant for the proper prostheses to be applied shortly after operation. It may be necessary to use a temporary prosthesis of soft rubber or soft acrylic until the edges of the defect in the maxilla have healed firmly enough to hold a permanent appliance.

Since most cancers of the antrum are infected prior to operation or will become infected postoperatively, a course of penicillin is begun immediately after surgery and continued for five to seven days. Three hundred thousand units are given intramuscularly every day.

Proper nutrition may or may not be a problem. For the first few days postoperative the patient is fed through an intranasal tube or is taught to pass the tube himself either through the mouth or through the nose (Martin, H. E.). If the temporary prosthesis fits well, the patient may eat as soon as possible. When the defect in the roof of the mouth is large, it may be difficult to prepare a temporary prosthesis sufficiently tight to allow adequate diet by mouth. Then intranasal feedings are continued as long as is necessary, up to two or three weeks occasionally. The diet, whether by tube feeding or by mouth, consists of adequate amounts of minerals, salt, vitamins and calories. A standard diet of our hospitals is termed a high vitamin, high caloric (3000 calories) liquid diet. As a rule none of these patients suffers from malnutrition after the operation. Some who have had intensive pain and infection prior to operation begin to gain weight promptly after the growth and infection have been removed and proper nutrition maintained.

Modification of operation for advanced antral cancer. The above description of operative technic covers the ideal case. Not infrequently cancer of the antrum is seen late in the course of the disease when the growth has penetrated through the floor of the antrum into the mouth, or has invaded the nasal cavity, nasopharynx, or extended through the skin. In the latter case it will be impossible to save the cheek for closure. The surgeon then performs an electrosurgical excavation, *so to speak*, without attempting to save the skin, the object being to remove the growth with as wide a margin as is necessary for safety. Evident skin involvement precludes the typical Fergusson incision. The growth is attacked directly through the cheek with a strong electrosurgical cutting current, the size, shape, and position of the incision being governed entirely by the problem at hand. Often in these cases, the anterior wall of the antrum is destroyed so the growth may be looped out with an electrosurgical curet carrying a strong cutting current. This electrosurgical curettage serves to clean out the antrum down to solid bone. Attacking the vascular cancer directly causes brisk bleeding since the large vessels are not coagulated by the electrosurgical curet passing rapidly through the growth. If, however, the surgeon works quickly and gets out all of the bleeding vegatative growth, hemorrhage can be temporarily controlled by pressure with gauze packs. To secure permanent hemostasis, the gauze is slowly removed and the ball coagulator followed over the raw surface, sealing the bleeders and destroying the growth. The growth is followed into the surrounding tissues or cavities, the nose, nasopharynx, orbit, pterygoid fossa, or the masseter muscle. In these cases radium tubes in rubber cots are carefully applied.

When the floor of the orbit is encroached upon, it should be removed. This might displace *the eyeball to the extent of causing* double vision, a complication not to be compared with the recurrence of the growth. If the orbital plate is perforated and the orbit has been entered by the growth, excochleation is necessary. Whenever this question is anticipated, the patient should be prepared for such radical procedure by carefully explaining all the possibilities to him prior to operation.

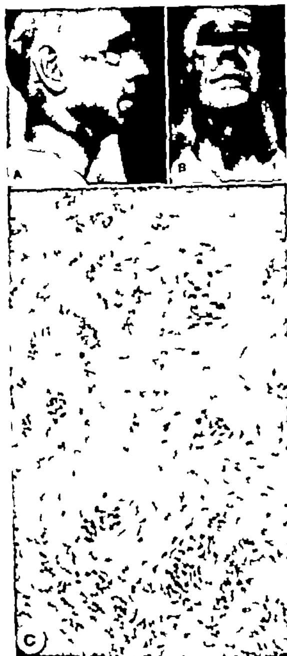


Fig. 374

A and B Postoperative view of patient with carcinoma of the antrum. First complaint was a growth extending down into the mouth from the antrum. He had received an injury several months before At operation (1929) through Fergusson incision, growth was found to spring from the lateral antral wall near the base of the zygoma. It was perfectly circumscribed and was attached at no other point The erosion of the floor of the antrum was by pressure only Following postoperative radiation therapy the skin over the antrum sloughed. These illustrations were taken after plastic repair This case illustrates the importance of *applying* a skin graft to the under side of the cheek, as described in the text and illustrations of operative technic. Note enlarged lymph nodes in the neck which appeared five years after the original operation

C Photomicrograph showing an unusual type of scirrhous carcinoma occasionally found in the antrum

Secondary repair No attempt is made to close the cheek after operation on these extensive cases, rather the wound is left widely open and packed with iodoform gauze and appropriately treated postoperatively Several months later, when mucous membrane and skin edges have grown together and time has shown that recurrence is not likely, the face is closed by a suitable pedicle graft walked up from some other part of the body (Fig 374) In all cases we feel that the opening into the mouth should remain for purposes of repeated inspection Our experience with properly fitting prostheses has strengthened this opinion

Prognosis. The outcome of malignant tumors of the antrum is not good, largely because the patients come late after the disease has invaded bone and neighboring structures. Our best results have been in the early cases where radium x ray and surgery were used in combination Growths on the nasal side or floor of the sinus, being accessible and giving symptoms early, offer a better prognosis than those which arise on the posterior wall roof and upper lateral wall, early invading the pharynx, orbit, zygoma, and pterygoid fossa. New (1935) followed thirty patients who were treated for primary antral malignancy for five years or more and found 40 per cent were free of disease

CARCINOMA OF THE ETHMOID SINUSES

Anatomy

The ethmoid labyrinth is composed of exceedingly thin bone enclosing a group of air cells which vary in number, averaging about nine They are arranged in three groups anterior middle and posterior Laterally they are enclosed by a thin oblong plate of bone, the *lamina papyracea* or orbital plate, which forms a part of the medial wall of the orbit and articulates above with the orbital part of the frontal bone which here forms the roof of the ethmoid cells Anteriorly, the lamina papyracea articulates with the lacrimal bone while below, by its union with the orbital surface of the maxilla the air sinuses in both situations are completed Posteriorly the lamina papy

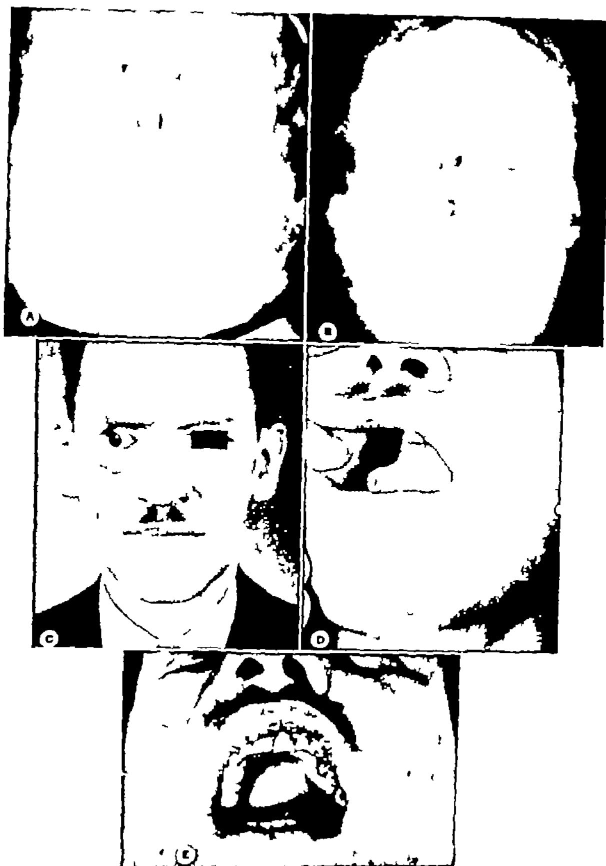


Fig. 375 Meningioma involving antrum and right maxilla. Complaint was pain in the right face. A sinus developed in the posterior part of the right hard palate; repeated biopsy showed granulation tissue and osteomyelitis.

A. Roentgenogram before operation showing extensive destruction of all antral walls. A radical antral operation was done by the Caldwell-Luc method. The antrum was fairly clear but all the antral walls were involved by a dense fibrous growth. Frozen section showed sarcoma. A few days later, through a Ferguson incision, the right maxilla was resected.

racea articulates with the sphenoid and at its posteroinferior angle for a variable distance with the orbital process of the palate bone, both of which serve to close in the air cells.

The medial aspect of the ethmoid labyrinth displays the convoluted conchae or tubinates usually two in number the middle and superior occasionally three (the third being designated the supreme) In cases in which there are ethmo-turbinates they are separated by a deep groove the superior meatus into which the posterior ethmoid cells open The middle meatus is a deep groove below the middle turbinate, running along the inferior surface of the ethmoid labyrinth It receives the openings of the middle ethmoid cells which project into the meatus, forming a rounded elevation called the *ethmoidal bulla* In front of and below this is a groove, the hiatus semilunaris, which by articulation above with adjacent bones is converted into a canal, the infundibulum which runs upward and forward to form a channel of communication with the frontal sinus and the anterior ethmoid cells.

Incidence

Primary carcinoma of the ethmoid labyrinth is the next most frequent sinus cancer after that of the antrum Most cases occur between the ages of forty and sixty the average age in our series being forty nine There were six males three females.

Clinical Behavior

Symptoms tend to run a comparatively long course before the patient presents himself for diagnosis the average time being two years eight months.

1 Case	1 month
1 Case	3 months
1 Case	7 months
1 Case	1 year
2 Cases	2 years
1 Case	3 years
1 Case	6 years
1 Case	9 years

The most common initial symptom is *unilateral nasal obstruction* Next in frequency is *unilateral nasal bleeding* which sometimes takes the form of *bloody discharge*

Pain is next in frequency as a presenting complaint usually occurring over one side of the bridge of the nose but sometimes located in one eye or over one frontal region.

Swelling of one eye is occasionally the first indication of ethmoid carcinoma and is usually due to spread of secondary infection to the soft tissues of the orbit.

Anosmia was the first symptom in one of our cases and was associated with obstruction of the upper portion of the nose on one side by tumor and on the other by the septum displaced by the growth Later symptoms include bilateral nasal obstruction with extensive growth and septal displacement or destruction proptosis with invasion of the orbit by tumor lacrimation with involvement of the lacrimal sac apparatus, swelling of one side of the nose or face with extension of infection or growth, blocked ear, with posterior extension and involvement of the Eustachian orifice, cloudy vision

PHYSICAL FINDINGS

The most common finding on initial examination is a bleeding growth in one side of the nose with an associated purulent discharge A cluster of polyps is frequently present

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B Roentgenogram showing loss of bone by operation

C Photograph of patient showing scar and rather flat cheek. Due to the fact that the floor of the orbit was lost patient had double vision At operation, the skin flap was lined with a split thickness graft. Healing per primum.

D Result after plastic operation by E. A. Hanrahan (see Chapter XXI) It is interesting to note that the skin of the face was dissected away from the graft The graft had adopted sufficient circulation to allow it to be split away from the cheek. A dermal graft was interposed with marked improvement in the cosmetic result. Now two years post operative there has been return of pain in right side of head Cranial exploration revealed involvement of branches of V nerve by tumor Section of nerve relieved pain.

E. Photograph showing well fitting prosthesis.

Other findings in order of frequency are orbital cellulitis, proptosis papilledema enlargement of the middle turbinate, optic *atrophy and in one case, the entire hard and* soft palate were replaced by a nodular mass.

Metastases were reported in only one case and those to the nodes at the angle of the jaw

X ray findings in order of frequency, are as follows

1 Clouding of the ethmoids on one side
2. Destruction of the medial wall of the orbit
3 Clouding of all the sinuses
4 Destruction of the base of the skull
5 Destruction of the posterior wall of the antrum
6 Tumor mass obliterating the optic foramen

Treatment

As in the treatment of cancer of the antrum, the treatment of cancer of the ethmoid sinuses is often a combination of surgery and radiation therapy Many authorities rely entirely upon radiation therapy It is not always possible actually to determine from the outside the exact extent of the growth therefore it would *seem advisable in certain cases to open the* face through an incision alongside the nose for removal of as much growth as possible cleaning out the ethmoid cells and the local application of radium (see Fig 355)

Roentgen therapy is given through two anterior ports. The eyes are protected with a suitable shield and the beam of x rays is directed through the cheek and lateral side of the nose The port size is about 4 x 5 cm Patients are treated three times a week and given 300 r measured in air per treatment The factors are 200 Kv 50 cm T.S D 15 Ma ½ mm. Cu + 1 mm Al filter The dose is taken up to about 3000 r per port If the lesion has already broken through the confines of the ethmoid sinuses then a lateral port is added using the same physical factors.

To this is added intranasal radium therapy Radium tubes, having 1 mm Platinum and iridium (10 per cent) walls, are placed in rubber cots of suitable size to cover the primary growth and inserted into one or both nostrils *as indicated by the case at hand If the growth* has extended into the nasopharynx radium cots are also placed there If possible the tumor dose should reach 6000 r–8000 r combining *x ray and radium*

CARCINOMA OF THE FRONTAL SINUSES

Anatomy

The frontal sinuses are two cavities situated immediately above the root of the nose between the two tables of the frontal bone. Each *sinus at its most dependent* part communicates by means of the nasofrontal duct either directly with the middle meatus of the nose or indirectly with that channel through its infundibulum *A bony septum separates the two* sinuses.

The frontal sinuses vary considerably in size and shape The anterior wall is thickest the floor thinnest

Incidence

Primary carcinoma involves the frontal sinuses next after the ethmoids in frequency of occurrence The average age in four cases was forty-eight (25 40 62 and 65) Two patients were men two women

Clinical Behavior

Symptoms are relatively vague so that a considerable time usually elapses before definitive diagnostic measures are begun. The duration of symptoms in four cases who presented themselves at the Johns Hopkins Hospital were as follows 5 months 9 months 1 year 2 years (with average duration of 12½ months)

The commonest presenting complaint is *unilateral frontal headache* usually constant and not influenced by time of day or change in position Swelling and proptosis of one eye is *next in frequency and usually indicates* downward displacement or destruction of the floor of the sinus, although it may represent infec

tion or edema associated with the adjacent growth.

Obstruction and discharge in one side of the nose is next in frequency as a presenting symptom

Later symptoms include double vision broadening of the base of the nose and swelling of the inner canthus of the opposite eye

PHYSICAL FINDINGS

In the early stages a diagnosis of frontal sinus carcinoma may be difficult or impossible to make on physical examination alone Pus may be seen in one side of the nose originating in the region of the nasofrontal duct. One side of the nose may be partially or completely filled with polyps, biopsy of which may or may not reveal the underlying malignant process. It has been our experience that squamous epithelium occurring in a nasal sinus should lead to suspicion of carcinoma. It rarely results from infection

Later in the disease process, with displacement or destruction of the bony walls, the base of the nose may be broadened or a defect is palpable in the anterior plate of the frontal sinus through which a cystic tumor mass may sometimes be felt

ROENTGENOGRAPHIC FINDINGS

Roentgenographic findings show clouding of the involved frontal sinus, usually with fuzzing of the sinus margins. The clouding may involve the opposite frontal sinus and, with superimposed infection the ethmoids and antra on the same and opposite side.

Histology

Three of the cases were reported *squamous cell carcinoma*, the other simply *carcinoma*

TREATMENT

The diagnosis of carcinoma of the frontal sinuses is usually made by operative exploration of the sinuses and removal of some of the tissue for diagnosis. A presumptive diagnosis may be given ahead of time on the basis of the symptoms and x ray examination Our experience with these tumors is limited After the diagnosis has been established, radium is applied directly in the frontal sinuses at operation followed by x ray therapy

CARCINOMA OF THE SPHENOID SINUSES

Primary carcinoma of the sphenoid sinus is rare Carcinomatous invasion of the sphenoid sinuses from carcinoma in the nasopharynx or ethmoids is not uncommon. In the files of the Johns Hopkins Hospital one case of primary basal cell carcinoma of the sphenoid was encountered This tumor occurred in a thirty year-old, white male whose complaint was nasal obstruction of a constant character Twelve weeks prior to admission he complained of a constant right-sided headache starting suddenly Five weeks prior to admission diplopia developed On physical examination the essential findings were paralysis of the right 6th cranial nerve A roentgenograph showed a mass in the middle fossa of the skull with erosion of the right side of the sella turcica. Needle biopsy on craniotomy showed a nonspecific basal cell carcinoma (SP # 66181) There has been no follow up on this case

TREATMENT

The treatment of carcinoma of the sphenoid sinuses would seem to be radiological except for the surgical opening and draining of the sinus and securing of tissue for microscopic examination

We have frequently curetted out the sphenoid sinuses when operating for carcinoma of the antrum that has invaded the ethmoids and sphenoids. Radium has been applied close to the sphenoid but we have never had occasion to put radium directly in the sphenoid sinus.

CARCINOMA OF THE NASAL MUCOUS MEMBRANE

Primary cancer of the nasal mucous membrane is a rarely encountered disease. Most malignant tumors found in the nasal cavities are secondary to growths in the accessory sinuses, nasopharynx, skin and orbits. Includ

Other findings in order of frequency are orbital cellulitis proptosis papilledema enlargement of the middle turbinate optic atrophy and, in one case, the entire hard and soft palate were replaced by a nodular mass

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CARCINOMA OF THE SPHENOID SINUSES

Primary carcinoma of the sphenoid sinus is rare Carcinomatous invasion of the sphenoid sinuses from carcinoma in the nasopharynx or ethmoids is not uncommon In the files of the Johns Hopkins Hospital, one case of primary basal cell carcinoma of the sphenoid was encountered. This tumor occurred in a thirty year-old, white male, whose complaint was nasal obstruction of a constant character Twelve weeks prior to admission he complained of a constant right sided headache starting suddenly Five weeks prior to admission diplopia developed. On physical examination, the essential findings were paralysis of the right 6th cranial nerve A roentgenograph showed a mass in the middle fossa of the skull with erosion of the right side of the sella turcica. Needle biopsy on craniotomy showed a non-specific basal cell carcinoma (SP #66181) There has been no follow up on this case

TREATMENT

The treatment of carcinoma of the sphenoid sinuses would seem to be radiological except for the surgical opening and draining of the sinus and securing of tissue for microscopic examination

We have frequently curetted out the sphenoid sinuses when operating for carcinoma of the antrum that has invaded the ethmoids and sphenoids. Radium has been applied close to the sphenoid, but we have never had occasion to put radium directly in the sphenoid sinus.

CARCINOMA OF THE NASAL MUCOUS MEMBRANE

Primary cancer of the nasal mucous membrane is a rarely encountered disease. Most malignant tumors found in the nasal cavities are secondary to growths in the accessory sinuses nasopharynx, skin and orbits Includ

Other findings in order of frequency are orbital cellulitis proptosis papilledema enlargement of the middle turbinate optic atrophy and in one case the entire hard and soft palate were replaced by a nodular mass.

Metastases were reported in only one case and those to the nodes at the angle of the jaw

X ray findings, in order of frequency are as follows

1 Clouding of the ethmoids on one side
2 Destruction of the medial wall of the orbit
3 Clouding of all the sinuses
4 Destruction of the base of the skull
5 Destruction of the posterior wall of the antrum
6 *Tumor mass obliterating the optic foramen*

Treatment

As in the treatment of cancer of the antrum, the treatment of cancer of the ethmoid sinuses is often a combination of surgery and radiation therapy Many authorities rely entirely upon radiation therapy It is not always possible actually to determine from the outside the exact extent of the growth therefore it would seem advisable in certain cases to open the face through an incision alongside the nose for removal of as much growth as possible cleaning out the ethmoid cells and the local application of radium (see Fig 355)

Roentgen therapy is given through two anterior ports The eyes are protected with a suitable shield and the beam of x rays is directed through the cheek and lateral side of the nose The port size is about 4 x 5 cm Patients are treated three times a week and given 300 r measured in air per treatment The factors are 200 Kv 50 cm T.S D 15 Ma, ½ mm. Cu + 1 mm Al filter The dose is taken up to about 3000 r per port If the lesion has already *broken through the confines of* the ethmoid sinuses then a lateral port is added using the same physical factors.

To this is added intranasal radium therapy Radium tubes having 1 mm. Platinum and iridium (10 per cent) walls, are placed in rubber cots of suitable size to cover the primary growth and inserted into one or both nostrils as indicated by the case at hand If the growth has extended into the nasopharynx radium cots are also placed there If possible the tumor dose should reach 6000 r–8000 r combining x ray and radium

CARCINOMA OF THE FRONTAL SINUSES

Anatomy

The frontal sinuses are two cavities situated immediately above the root of the nose between the two tables of the frontal bone Each sinus at its most dependent part communicates by means of the nasofrontal duct either directly with the middle meatus of the nose or indirectly with that channel through its infundibulum A bony septum separates the two sinuses.

The frontal sinuses vary considerably in size and shape. The anterior wall is thickest the floor thinnest

Incidence

Primary carcinoma involves the frontal sinuses next after the ethmoids in frequency of occurrence The average age in four cases was forty-eight (25 40 62, and 65) Two patients were men two women

Clinical Behavior

Symptoms are relatively vague so that a considerable time usually elapses before definitive diagnostic measures are begun The duration of symptoms in four cases who presented themselves at the Johns Hopkins Hospital were as follows 5 months 9 months 1 year 2 years (with average duration of 12¾ months)

The commonest presenting complaint is *unilateral frontal headache* usually constant and not influenced by time of day or change in position Swelling and proptosis of one eye is next in frequency and usually indicates downward displacement or destruction of the floor of the sinus, although it may represent infec

tion or edema associated with the adjacent growth

Obstruction and discharge in one side of the nose is next in frequency as a presenting symptom

Later symptoms include double vision, broadening of the base of the nose and swelling of the inner canthus of the opposite eye

PHYSICAL FINDINGS

In the early stages a diagnosis of frontal sinus carcinoma may be difficult or impossible to make on physical examination alone Pus may be seen in one side of the nose originating in the region of the nasofrontal duct. One side of the nose may be partially or completely filled with polyps, biopsy of which may or may not reveal the underlying malignant process. It has been our experience that squamous epithelium occurring in a nasal sinus should lead to suspicion of carcinoma It rarely results from infection

Later in the disease process, with displacement or destruction of the bony walls, the base of the nose may be broadened, or a defect is palpable in the anterior plate of the frontal sinus through which a cystic tumor mass may sometimes be felt

ROENTGENOGRAPHIC FINDINGS

Roentgenographic findings show clouding of the involved frontal sinus, usually with fuzzing of the sinus margins. The clouding may involve the opposite frontal sinus and, with superimposed infection the ethmoids and antra on the same and opposite side

Histology

Three of the cases were reported *squamous cell carcinoma* the other simply *carcinoma*

TREATMENT

The diagnosis of carcinoma of the frontal sinuses is usually made by operative exploration of the sinuses and removal of some of the tissue for diagnosis. A presumptive diagnosis may be given ahead of time on the basis of the symptoms and x ray examination Our experience with these tumors is limited After the diagnosis has been established, radium is applied directly in the frontal sinuses at operation, followed by x ray therapy

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CARCINOMA OF THE NASAL MUCOUS MEMBRANE

Primary cancer of the nasal mucous membrane is a rarely encountered disease. Most malignant tumors found in the nasal cavities are secondary to growths in the accessory sinuses, nasopharynx, skin and orbits Includ

ing two cases of squamous cell carcinoma on the columella we have seen a total of six cases which could be called cancer of the nasal mucosa These cases are discussed along with tumors of the paranasal sinuses because of the similarity of the mucous membrane in the two locations

Histology

All of the cancers which we have observed springing from the mucous membrane of the nose have been squamous cell carcinoma They were of a fairly undifferentiated variety except the two occurring on the columella which were well differentiated



Fig 376. Squamous cell carcinoma of the nasal septum at the junction between the skin and mucous membrane best treated by direct application of radium This patient had a growth on each side of the septum which was destroyed by direct application of radium on each side totaling 800 mg. hr November 27 1941 to Dec. 10 1941 Later he developed metastasis in the midline of the submental region which was treated by bilateral suprahyoid neck dissection Patient well May 11 1949 at age of 84 years.

Clinical Behavior

When the growth begins on the columella at the junction of the nasal mucous membrane with the skin the first symptom is the appearance of a tumor or a sore in the nose There may or may not be bleeding Occurrence of the growth farther up in the nasal cavity calls the patient s attention to the malady by nasal obstruction and bleeding in two cases by direct extension through the skin.

On physical examination an ulcer or wart like growth appears on one or both sides of the columella at the junction of the mucous membrane and skin (Fig 376) The two cases which we have treated had cancer on both sides of the columella without actual perforation of the cartilage Higher up the growth may appear as an ulcer on the turbinate or as a polypoid growth springing from the mucous membrane It bleeds to touch

Clinically it may be difficult to determine whether the growth is coming down from the turbinates or has grown into the posterior nares from the nasopharynx A recent case was that of a colored man having localized cancer on the anterior end of the left inferior turbinate Nasal examination localized the tumor quite definitely a rather unusual circumstance The turbinate was removed with electrosurgery through a paranasal incision and the nose turned back (see Fig 356)

Carcinoma of the nasal cavity sometimes grows directly through the nose and presents on the skin (Fig 379 A–D) Patient of Edward Lewison.)

Roentgenographic Findings

Roentgenological examination of the sinuses helps in determining the extent of the growth Figure 377 is a roentgenogram of a patient referred by Theodore A Schwartz. Biopsy of a polypoid growth obstructing the right nostril revealed squamous cell carcinoma The roentgenograph shows soft tissue extension into the right antrum At operation the growth was found to spring from the inferior turbinate and erode the antral wall It was removed electrosurgically through an incision along the right side of the nose (ascending limb of Fergusson incision) Radium was applied directly at operation the dose being 600 mg hr

Figure 378 is a roentgenograph of a patient with nasal obstruction of many months duration Note that the shadow filling the right nares is definitely radio-opaque suggesting the presence of calcium or bone Benjamin

Rich who referred this patient operated and removed a rhinolith which was more or less horseshoe shaped

TREATMENT

Treatment of carcinoma of the nasal mucous membrane is by radiation therapy or surgery, or preferably a combination of the two in extensive cases. The choice will depend upon the problem at hand. (See Chapt XII)



Fig. 377 Roentgenogram of squamous cell carcinoma of the mucous membrane of the right naris. Note that shadow extends through into the antrum. This patient was treated as follows

The vertical limb of a Ferguson incision was made down along the right side of the nose under the ala and down the midline of the lip. The antrum and nasal cavities were opened, the growth removed electrosurgically and radium applied x-ray therapy given postoperatively

Carcinomas of the muco-cutaneous junction of the columella are treated by the direct application of radium element Tubes are laid against the growth and a small lead plate slipped in alongside to protect the ala of the nose Our patient shown in Figure 376 was treated with radium in November 1941, there was no perforation of the septum. In about a year, he returned with a small midline submental nodule Aspiration biopsy showed squamous cell carcinoma A bilateral suprahyoid neck dissection was done and the patient has remained well for eight years.

One of our earlier cases of carcinoma high up in the mucous membrane in the nose was treated well over fifteen years ago Biopsy showed a moderately undifferentiated but rapidly growing tumo with marked metaplasia. Radium was applied in the nose against the growth, which seemed to spring from the left lateral nasal wall *Consequently under general anesthesia* the antrum was opened and radium applied against the nasoantral septum This treatment was followed by x ray therapy There was marked reaction with severe pain



Fig. 378. Roentgenogram of rhinolith (calcified foreign body in the nose)

and radio-osteonecrosis, resulting in the loss of part of the bone of the floor of the orbit. The patient has remained well since the treatment. There have been no metastases If this patient were treated today we would insist on exploration of the nose and sinuses through a paranasal incision (Fig 355) in order to remove all of the growth possible and radiate any suspicious areas incompletely removed Such an operation was refused by the patient whose history was just given

Metastases to the cervical lymph nodes from cancer of the nasal mucous membrane would seem to occur very late In the few cases we have had the opportunity to treat and observe metastases in only one developed (pa

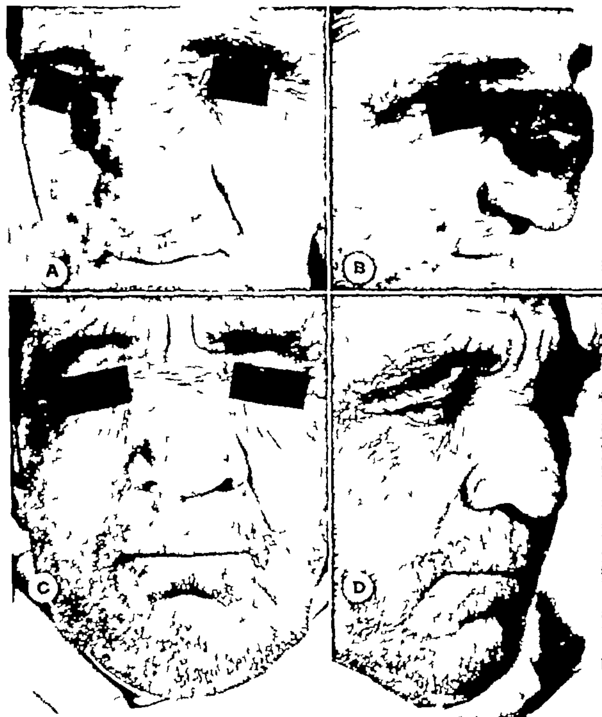


Fig. 379 Rapidly growing squamous cell carcinoma of the nasal mucosa

A. Front view

B Side view Patient seen with Edward Lewison, treated with approximately 12,000 r to the nose through 2 external ports (July and August 1946) plus an additional 750 mg. hr of radium in the nostrils

C and D 2 years later no evidence of recurrence 3 yrs. It is interesting to note that thi patient came in on May 20 1947 with a carcinoma of the floor of the mouth which was treated with 3000 r through intraoral cone followed by implantation of 9 mc. of radon This lesion is also well to date

tient shown in Fig 376) In three the patients have been too recently treated to permit conclusions In the one cited above and a second case Ward treated with Howard A Kelly prior to 1927 no metastases developed for over twelve years as long as the patient was followed

Extensive malignant involvement such as

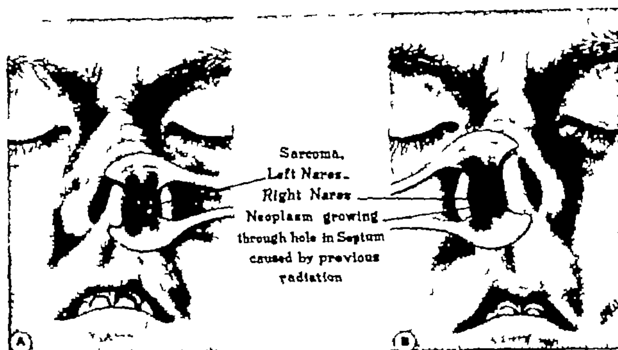


Fig. 380 Radical resection of superior maxilla for sarcoma of the antrum. Patient, white female aged 56 years We treated her in 1935 for early carcinoma of nasal wall, left antrum, by placing radium tubes in the nose and antrum and by x-ray therapy No symptoms until several months ago when she noticed tearing of left eye. Clinical and roentgen examinations, negative. Biopsy of granulations in nose and antrum 3 months ago negative. One month ago tumor noticed in left nostril. Biopsy—undifferentiated carcinoma. (Patient treated in cooperation with Dudley Babb.)

A. Artist's representation of neoplasm in left naris, apparently springing from inferior turbinate.

B Neoplasm extends through opening in nasal septum caused by intranasal radiation with radium 14 years before. Growth is not attached in right naris.

illustrated in Figure 379, should first be thoroughly treated with x ray therapy This patient was given a total dose of 12 000 r to the nose through two external ports during July and August 1946 followed by 750 mg hr of radium therapy in the nostrils. Had he not responded to this heroic therapy operation would have been advised The operation would have consisted of thorough electrosurgical excavation of all possible growth and the application at the operating table of radium to any areas of lingering disease Without heroic methods of therapy the outlook of these patients is very bad

MENINGIOMA INVOLVING THE ANTRUM

Occasionally meningiomas have invaded the sinuses and deeper structures of the face Our attention was called to this by our patient illustrated in Figure 375 Since Charles Bagley has had similar cases we asked him to furnish the following discussion He and George W Smith have prepared an article entitled 'Sphenoid



Fig. 380

C. Outline of modified Fergusson incision with extension across bridge of nose permitting nose to be turned back to right exposing both nares. Compare Figure 355 C.



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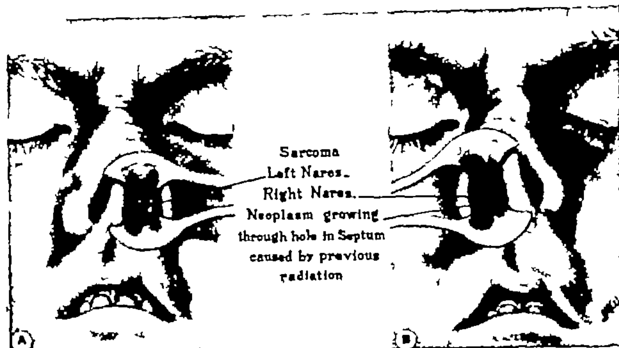


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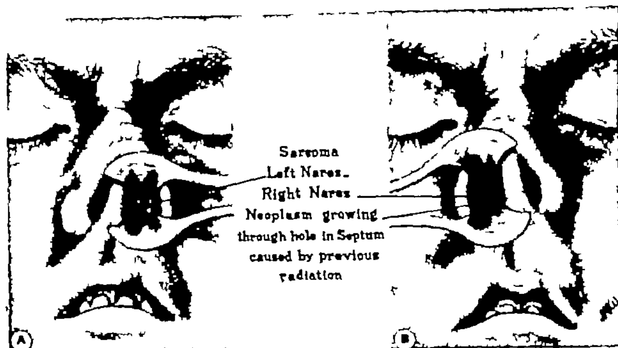


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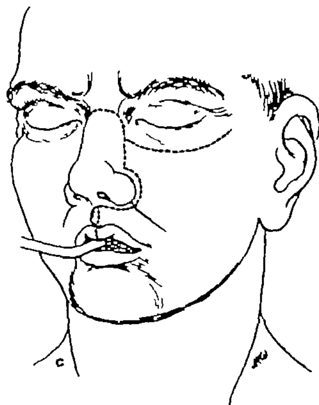


Fig. 380

C. Outline of modified Ferguson incision with extension across bridge of nose permitting nose to be turned back to right, exposing both nares. Compare Figure 355 C

Ridge Meningiomas with presentation of five cases" (in press)[1]

Intracranial tumors arising from the sphenoid ridge are not common These are usually meningiomas and located either deep, middle, or pterional on the ridge Frequently such tumors *will extend into and involve the orbit* Of less frequency is the sphenoid ridge meningioma which breaks through the cranial vau and involves the zygomatic fossa and par nasal sinuses Cushing and Eisenhardt, in the series of meningiomas, cite only one case i volving the paranasal sinuses and this extended into the antrum. (Case #5 of their pterional en plaque group) *Pterional meningiomas are prone to extensive involvement of adjacent bone and may pass through the bone into the* zygomatic and temporal fossae with involvement of the adjacent soft tissues.

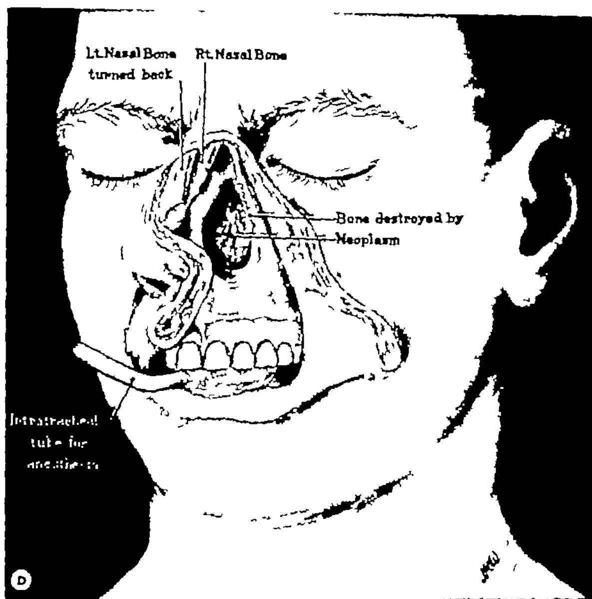


Fig 330

D Cheek opened through vertical limb of Fergusson incision and nose turned to right exposing tumor which was found to involve anterior wall of antrum and floor of orbit requiring horizontal Fergusson incision for adequate approach as shown in "E."

The presence of supra zygomatic fullness

[1] Charles Bagley Jr., M.D Professor of Neurosurgery *University of Maryland School of Medicine*
George W Smith, M D Fellow in Neurosurgery *University of Maryland School of Medicine*

either with or without unilateral proptosis suggests a sphenoid ridge tumor with extension. These masses frequently are painful. X-ray evidence of involvement of the sphenoid ridge, either hyperostosis or erosion, most definitely localizes the lesions as being intracranial in origin and then extending into the face. The recognition of the intracranial origin of these tumors which present themselves by signs outside the cranial vault is important because of the apparent benign nature of these lesions in the early stages when gratifying surgical results may be expected. Also the danger of sarcomatous change or the presence of sarcoma in the meningioma must be kept in mind. The transcranial approach is the surgical route of choice.

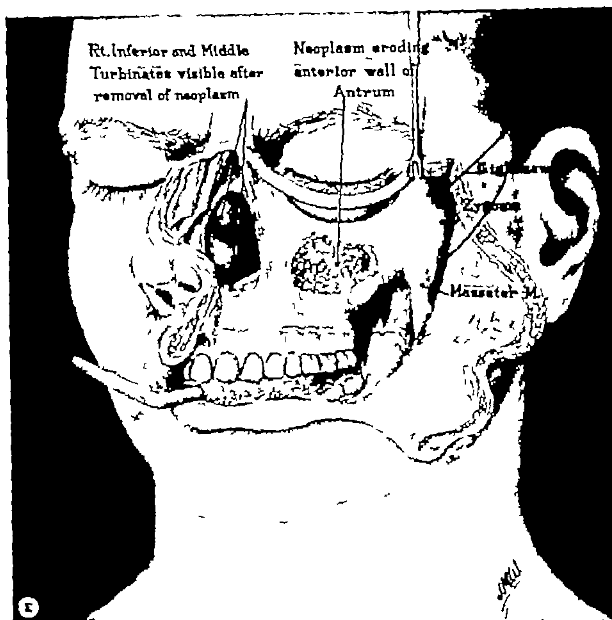


Fig. 380

E. Cheek completely turned back. Neoplasm has destroyed anterior wall of antrum and also extended into pterygoid fossa and nasopharynx.

Bagley and Smith in their series of sphenoid ridge meningiomas include two cases in which the tumor extended outside the cranial vault, one into the temporal and zygomatic fossae and the orbit and a second case extending into the right antrum, orbit, and temporal and zygomatic fossae. Their Case II, M. M. 55-

year-old white female presented complaints of pain behind the left eye for six years, and protrusion of the left eye and diminished vision of three years duration These symptoms were insidious and progressive Examination showed proptosis of the left eye At operation a tumor

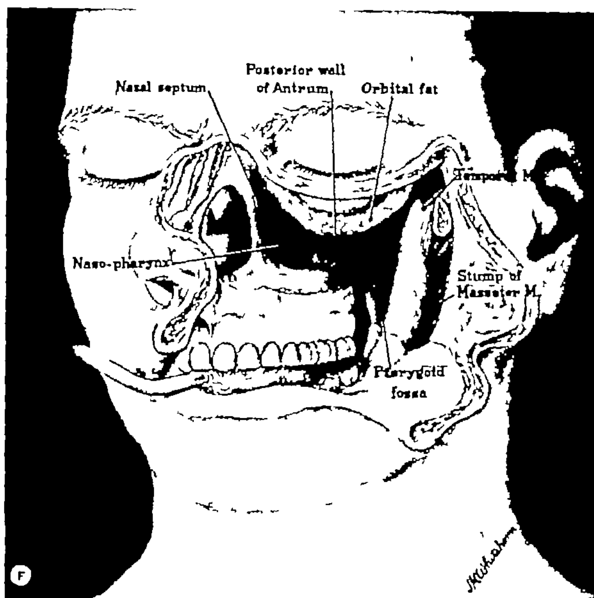


Fig. 380

F Electrosurgical removal of tumor completed. The floor of antrum and nose and the alveolar arch being uninvolved by the neoplasm were not removed Radium tubes contained in rubber cots were placed in nasopharynx and ethmoid region and against medial wall of orbit where the growth had invaded bone and were held in place by an iodoform gauze pack. A split thickness skin graft was sutured to inner surface of cheek and over temporal and pterygoid muscles and under surface of orbit and wound closed (See Fig. 372.) Pathology report on operative specimen—sarcoma. This case may be one of sarcoma developing after radiation therapy—an interesting speculation

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C. Preoperative A.P roentgenograph of skull, Case 4 There is a destructive process of the greater wing of the sphenoid (arrow 1) the lateral border of the right orbit a portion of the frontal bone and the right malar bone (arrow 2) (see text)

D Lateral roentgenograph of skull Case 4. Taken after injection of *10 cc Diodrast* into the operative cavity This shows (arrow) the cavity to extend from the floor of the anterior fossa downward to the level of the hard palate. The cavity measured 3 cm at its widest point.

E. Face view of skull, Case 4 Taken after injection of 10 cc. Diodrast into the operative cavity This view reveals the dye to be in the zygomatic fossa and starting to enter the right antrum and orbit (arrow)

F P.A. roentgenograph of skull Case 4 Taken following injection of 10 cc Diodrast into operative cavity The radio-opaque material (arrow) extends from the temporal fossa into the orbit and antrum.



Fig. 381

A P A. roentgenograph of skull, Case 2 Note the hyperostosis (arrow) of the sphenoid ridge and the orbit on the left (see text)

B Lateral roentgenograph of orbit, Case 2. Note area of increased density (arrow) of the orbit and the adjacent temporal bone also the increased density of the zygomatic fossa on the *left* side. The right (normal) orbit is shown for comparison.

of the left sphenoid ridge extended to involve the roof and lateral wall of the orbit zygoma, and temporal bones. The tumor had also invaded the orbit and temporal and zygomatic fossae The mass was removed and the proptosis disappeared A 6-year follow up showed that in May of 1949 she had the left eye enucleated because of glaucoma with uncontrollable pain Otherwise she was asymptomatic. X rays (Figs. 381 A and B) showed the characteristic hyperostosis of the left sphenoid ridge and increased density in the region of the left zygomatic fossa

Their case IV W T 40-year-old white male, was admitted with complaints of a mass in the right supra zygomatic area and proptosis of the right eye of four months duration He had x ray and radium treatments in 1929–1932 for a tumor located in the same area then diagnosed (without surgery or biopsy) as an osteogenic sarcoma. During the intervening years until May 1948 there were no symptoms except for severe periodic pain occurring over the right eye In June 1948 a swelling appeared in the right temporal region just posterior to the external canthus of the eye and progressed to the right frontal region during that month This swelling felt smooth and fluctuant. He received deep x ray therapy without improvement The tumor mass was aspirated several times and bloody fluid withdrawn X rays of the skull on admission (Fig 381 C) showed destruction of the malar bone, lateral margin of the right orbit a portion of the frontal bone and a portion of the greater wing of the right sphenoid. The working diagnosis of sphenoid ridge meningioma was made and a left transcranial surgical approach revealed a tumor which had eroded the lateral wall of the orbit the greater wing of the sphenoid the lateral wall of the maxilla and extended inferiorly into the antrum as far as the hard palate Tumor tissue was found in the temporal and zygomatic fossae and in the orbit Intracranially it impinged on the inferior surface of the right frontal and temporal lobes of the cerebrum The pathological report was meningioma which had undergone sarcomatous changes. The patient had deep x ray therapy but returned within two months with recurrence of symptoms X ray examinations showed extension of the bony destruction of the orbit and zygoma and in spite of further surgery and x ray therapy he expired three months later

Figures 381 D E, and F are prints of roentgenographs of skull after 10 cc of 35 per cent Diodrast were instilled into the operative defect following the surgical excision These clearly demonstrate the extent and limits of the tumor growth into the face

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Chapter XIV

TUMORS OF THE EYE AND ADNEXA

Charles E. Iliff, M.D.*

In this chapter tumors of the eye and adnexa will be considered in four classes Lids Conjunctiva Cornea and Sclera Intraocular and Orbital. These tumors embody almost every type found in the skin muscle mucous membrane blood vessels, lymph nerve tissues, and cartilage elsewhere in the body

Any satisfactory study of tumors must necessarily be based on pathological diagnosis and only tumors so examined are included here In such a study differential diagnosis is the first essential for it indicates clearly which surgical field ophthalmology otolaryngology neurosurgery or radiology can accomplish the best results The surgical methods and other procedures described are those commonly employed and found satisfactory at the Wilmer Institute

The differential diagnosis of tumors of the eye and adnexa is based on the following points

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Generalization can be made about two of these points only Age of Patient and Rate of Growth All others will be discussed in relation to specific tumors

Age of Patient. In children benign tumors of congenital origin are most commonly noticed very early in childhood though some escape detection until puberty or even later At this age with the exception of the retinoblastoma, malignancies are rare In older children benign tumors are still the most common but more consideration must be given to possible malignancy

In adults there is a sharp increase in the frequency of malignancy accounting for almost fifty per cent of all cases

Rate of Growth. In children benign tumors are slow in growth Malignant ones are extremely rapid in development

In adults the opposite is true Benign tumors such as the inflammatory pseudotumor enlarge rapidly while many of the malignant tumors, with the exception of the metastatic, enlarge slowly

For all the common tumors in this series the differential diagnosis is given, for such information on rare tumors the reader is referred to the bibliography

TUMORS OF THE LIDS

This material is based on a review of one hundred and twenty-six cases examined and treated over a ten year period by the staff of the Wilmer Institute of the Johns Hopkins Hospital In each of these cases the diagnosis was confirmed by *pathological section*

Of the one hundred and twenty-six lid tumors eighty two were benign and forty four malignant Thirty three of the benign tumors were congenital and in most cases, were discovered in early childhood The malignant tumors on the other hand were almost all carcinomas, and found in adult life, with the youngest patient in the group a woman of twenty

Thus, for practical purposes we can consider most lid tumors in children as being benign, and in such cases therapy can be conservative

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of the left sphenoid ridge extended to involve the roof and lateral wall of the orbit zygoma and temporal bones The tumor had also invaded the orbit and temporal and zygomatic fossae The mass was removed and the proptosis disappeared A 6-year follow up showed that in May of 1949 she had the left eye enucleated because of glaucoma with uncontrollable pain Otherwise she was asymptomatic X rays (Figs. 381 A and B) showed the characteristic *hyperostosis of the left sphenoid ridge and in*creased density in the region of the left zygomatic fossa

Their case IV W T 40-year-old white male was admitted with complaints of a mass in the right supra zygomatic area and proptosis of the right eye of four months duration He had x ray and radium treatments in 1929–1932 for a tumor located in the same area, then diagnosed (without surgery or biopsy) as an osteogenic sarcoma During the intervening years until May 1948 there were no symptoms except for severe periodic pain occurring over the right eye In June, 1948 a swelling appeared in the right temporal region just posterior to the external canthus of the eye and progressed to the right frontal region during that month This swelling felt smooth and fluctuant He received deep x ray therapy without improvement The tumor mass was aspirated several times and bloody fluid withdrawn X rays of the skull on admission (Fig 381 C) showed destruction of the malar bone lateral margin of the right orbit a portion of the frontal bone and a portion of the greater *wing of the right sphenoid* The working diagnosis of sphenoid ridge meningioma was made and a left transcranial surgical approach revealed a tumor which had eroded the lateral wall of the orbit the greater wing of the sphenoid the lateral wall of the maxilla and extended inferiorly into the antrum as far as the hard palate Tumor tissue was found in the temporal and zygomatic fossae and in the orbit Intracranially it impinged on the inferior surface of the right frontal and temporal lobes of the cerebrum The pathological report was meningioma which had undergone sarcomatous changes The patient had deep x ray therapy but returned within two months with recurrence of symptoms. X ray examinations showed extension of the bony destruction of the orbit and zygoma and in spite of further surgery and x ray therapy he expired three months later

Figures 381 D E, and F are prints of roentgenographs of skull after 10 cc. of 35 per cent Diodrast were instilled into the operative defect following the surgical excision These clearly demonstrate the extent and limits *of the tumor growth into the face*

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Chapter XIV

TUMORS OF THE EYE AND ADNEXA

Charles E. Iliff, M.D.*

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adults, on the other hand where half of the *tumors encountered are malignant* therapy ...st necessarily be radical making the com

TABLE 29

Differential Diagnosis, Primary Benign Lid Tumors

	Age of Appearance	Rate of Growth	Location	Appearance	Treatment
...vus	Usually noted in childhood or early adult life	Very slow	Anterior lid margin. On cilia line upper or lower	May or may not be pigment lobulated. Not friable does not ulcerate Firm	Surgical removal not sensitive to irradiation
...rmoid	Childhood	Very slow	Upper nasal or temporal quadrant of upper lid	Spherical mass solid or cystic	Surgical removal not sensitive to irradiation
...gioma	Childhood	May be slow or relatively rapid but usually self limited	Anywhere on lids	Capillary superficial bright red dilated vessels. Cavernous, deeper-bluish color of skin	Radio sensitive irradiation is therapy of choice
...uro-...ibroma	Childhood	Slow without limitation causes bone erosion	Temporal portion of upper lid or temporal fossa	Ptosis, thickened and pigmented skin. Increased hair over area. Café au lait spots over torso Bony defects demonstrated by x-ray	Surgical removal
...pilloma	Usually in adult life	May be slow or rapid	Mucocutaneous margin. More on lower than upper lid	Friable flat or pedunculated Bleeds easily Frequently necrotic margin with crusting	Surgical removal or beta irradiation
...rnu cu...taneum	Adult	Slow	Anywhere on lids Usually near margin	Watery grey avascular elevations	Surgical removal
...nthoma	Adult 40–60 more often female	Slow	Anywhere about lids but commonly nasally above or below	Flat surfaced slightly elevated masses yellowish in color	Surgical removal

...ete removal of the malignancy primary in ...portance

Benign Tumors of the Lids

Ida Mann has divided congenital abnormali... into three groups Those that are occasioned by simple arrest of development those *that are pure aberration* and those that are due not only to an arrest of development, but also to subsequent aberrant growth These can be further classified as

1 Tumors of one germ layer such as angiomas nevi and neurofibromas.
2 Tumors of both mesoderm and ectoderm

such as the teratoid tumors, dermoids and cholesteatomas.

3 Tumors of all three germ layers, such as the malignant teratoma.

Thirty three of the lid tumors were nevi, dermoids angiomas or neurofibromas and were considered to be on a congenital basis. Most, but not all were discovered in childhood so that the apparent differential cannot be made as dogmatically as the classification would indicate On the other hand it is extremely important to understand the common occurrence of the above listed tumors in children and the great rarity of primary malignant lid tumors It is for this reason the tumors have been so grouped (Table 29)

NEVI OR BENIGN MELANOMAS

(11 Cases) These congenital benign lid tumors may or may not be pigmented and are, therefore often unnoted until somewhat late in life In this series of eleven cases, two patients were in their fifth decade Nevi are situated on the anterior margin of the lid usually at the cilia line in most cases surrounding the cilia, and rarely extend to the conjunctival surface of the lid. Elevated irregular and lobulated these tumors are firm not friable and rarely become necrotic. Color ranges from pink to brown depending on the amount of pigment. When found in the upper and lower lids, nevi are usually in the contact position attesting to congenital origin and unrelated to the contact itself Changes in degree of pigmentation are probably due to premelanin changing to melanin (Reese) They seldom become malignant (Fig 382)

Differential Diagnosis. Nevi must be differentiated from

(1) Flat papillomas which appearing more often in the older age group may be lightly pigmented but usually to a lesser degree than are nevi Papillomas may break down and bleed easily since their frond-like extensions are very friable (pg 499)

(2) Carcinomas which occur in the older age group do not surround the cilia as do the nevi are hard non-pigmented and may be ulcerated

(3) Malignant melanomas, usually more heavily pigmented than the nevi, are more rapid in growth invasive and often ulcerated.

Pathology There has been considerable argument about the nevus cell, but it is generally considered to be of neurogenic origin (Masson) The large epidermoid cells are basically a Schwann cell and lie in clusters beneath a stretched, or slightly atrophic, epithelium The nevus cells may contain pigment, and, in addition, the basic layers of the epithelium may contain melanin similar to that found in the normal skin.



Fig 382. Nevi of upper and lower lid in contact position

Treatment. Nevi do not respond to irradiation No treatment is required, unless the nevus is a cosmetic blemish or enlarges. If this occurs it should be removed surgically In removing such a tumor for cosmetic purposes, the simple excision although expeditious, leaves an area without cilia. How disturbing this may prove to be depends largely on the sex and basic appearance of the patient. The following procedure is, therefore, used to maintain intact cilia line

General anesthesia is more satisfactory for plastic procedures on the lids than local novocaine infiltration which distorts the tissues. Since the nevus lies anterior to the tarsus an intermarginal incision with a small Bard-Parker knife is made behind the cilia and the posterior edge of the tumor This splits the lid anterior to the tarsus, to the depth of the retrotarsal margin, freely mobilizing both the tumor and all the tissue anterior to the tarsus.

The tumor is grasped with small toothed forceps and the lid put on stretch. With curved scissors two elliptical incisions are made starting on each side of the tumor and joining at a point level with the depth of the area undermined (Fig. 383 A). The triangle containing of dermalon or anacap six zero silk (Fig. 383 C). About one half millimeter of tissue only is picked up with each bite of the suture. Silk sutures are placed along the lid margin to approximate correctly the skin and tarsal segments.

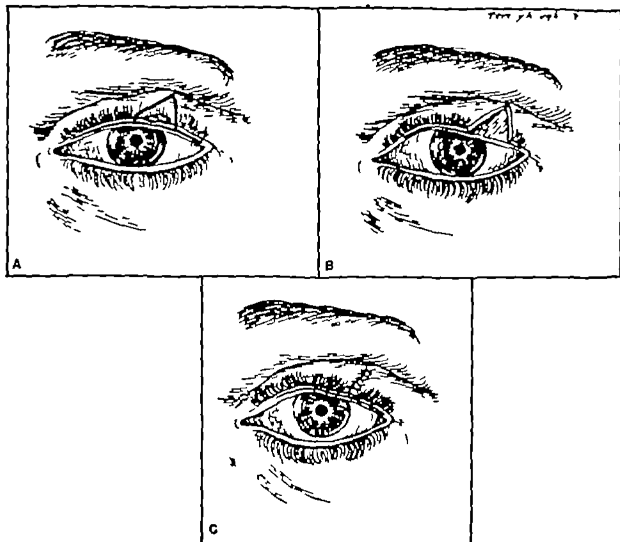


Fig. 383 Resection of Nevus

A Intermarginal incision splitting lid to depth of shaded area.
B Nevus excised—elliptical incisions.
C Skin and orbicularis closed re-establishing cilia line

the tumor is thus excised (Fig. 383 B). A fine six zero braided silk suture with atraumatic needle as used in corneo-scleral work is then passed vertically through the skin margins *at cilia level and the skin put on stretch in* order to approximate the elliptical edges. The orbicularis muscle is then sutured with two buried five zero plain catgut sutures and the skin closed with very fine interrupted stitches

The lid contour maintained by the tarsal plate has not been disturbed and the skin and subcutaneous tissue stretch to give easy closing of the wound and to preserve an intact cilia margin. On the fourth or fifth day sutures are removed.

When there is any doubt as to possible malignancy of the nevus, a full thickness lid

excision is the only safe procedure. (See surgical procedures of malignant lid lesions.)

DERMOIDS

(9 Cases) These are slowly enlarging congenital tumors which though usually noted in early childhood, may lie dormant for years. They are most frequently found in the upper lid, and may be either on the nasal or temporal side. Typically situated five or more millimeters from the lid margin they are sometimes connected by a slender stalk to an orbital dermoid (Fig 384) Bader has reported one case in which the dermoid was at the cilia line The tumors may be solid or cystic, are roughly spherical in shape, and vary in diameter from that of a small pea to one of several centimeters. Cystic dermoids transilluminate clearly

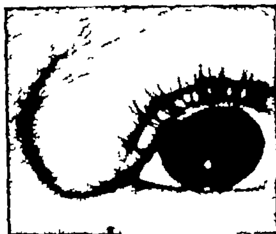


Fig 384 Dermoid upper lid—temporal side

Differential Diagnosis. Dermoids must be differentiated from

(1) Chalazia which go through an inflammatory stage with a definite time of onset and often with a small amount of discharge at the mouth of the gland (Figs. 385 and 398)

(2) Angiomas, which are usually almond shaped and compressible and impart a bluish cast to skin

(3) Neurofibromas, which have associated congenital defects such as café-au lait spots over the trunk pigmentation with increased thickening hairyness of the skin over the tumor and bone defects.

Pathological Diagnosis. Typical dermoids show sebaceous material with hair glands, or muscle fibre formation surrounded by keratinized stratified epithelium and a connective tissue wall.

Treatment. Dermoids do not respond to irradiation Surgical removal is by a skin incision over the tumor and parallel to the lid margin. The superficial muscle and fascia are spread by blunt dissection When the dermoid is cystic an attempt should be made to remove the sac without rupturing it In event of rupture all of the sac wall should be removed to prevent postoperative irritation and possible recurrence. The skin is closed by very fine dermalon interrupted sutures with the bites about one half millimeter only on either side of the incision. Stitches usually fall out or are easily removed on the third or fourth day



Fig. 385 Chalazion temporal side of lower lid

ANGIOMAS OR HEMANGIOMAS

(8 Cases) These are located anywhere on the lid and are congenital benign tumors. They may either be isolated or associated with extensive growth in the globe or in the orbit. This type of tumor is usually so noticeable as to be easily detected by parents when the patient is very young Occasionally it is overlooked until puberty or even until pregnancy when it frequently enlarges. One important characteristic of most angiomas is that growth is relatively self limited.

There are two types

1 The Capillary Hemangioma occurring

fairly frequently consists of a bright red spot of dilated tortuous capillaries which lie superficially in the skin Its surface may present a rough mulberry appearance or be smooth and sacular The tumor is usually small and quite compressible There were no cases of capillary

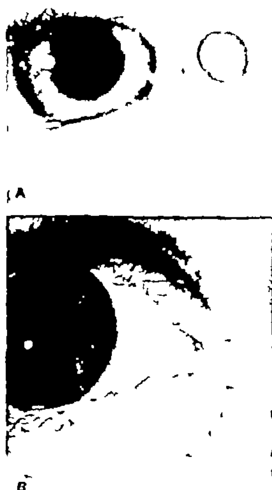


Fig 386

A. Hemangioma—inner canthus.

B Hemangioma after 7 gm seconds contact, Beta irradiation therapy

hemangioma in this series for clinical diagnosis was so obvious that a biopsy was unnecessary and irradiation therapy was used as a matter of course (Fig 386 A and B)

2 *The Cavernous Hemangioma* consists of a deeper mass of dilated blood spaces which imparts a bluish color to the overlying skin. The tumor is composed of blood spaces in : of connective tissue and its consistenc palpation depends upon the ratio of the Thus some of these tumors are quite com ible, others have a rubbery or corded Pressure of surrounding connective tissue makes the mass almond in shape. On p tion it may feel encapsulated but one finds a plane of cleavage when attem surgical removal. In the experience a Wilmer Clinic, afferent and efferent v have been numerous rather than few frequently stated in the literature (Fig A and B) All eight angiomas of this were of the cavernous type Six were in dren under a year one in a woman of tw and the other in a man of forty-eight. All situated in the upper lid. One had the i rect clinical diagnosis of neurofibroma, an of dermoid

Differential Diagnosis. Superficial capi *hemangiomas present no diagnostic probl*

Cavernous hemangiomas, when as in r or dark-complexioned persons no bluish c visible may diagnostically be confused w

(1) Isolated neurofibromas with frequ associated café-au-lait spots and other genital anomalies.

(2) Dermoids which are likely to be sphe rather than almond shaped and which u larger cystic form show up on transillum tion Dermoids tend to be located tempo or nasally on the upper lid whereas there specific location for angiomas as has noted earlier Neither dermoids nor neu bromas are radio-sensitive angiomas ar tremely so

(3) Aneurysms of the lids which are as ated with orbital involvement and produ bruit Their occurrence can usually be tr to a very definite time of onset and they frequently associated with injury

Pathology The superficial capillary her giomas consist of a close aggregate of tort dilated capillaries (Fig 387 C)

Cavernous hemangiomas are compose thin-walled blood spaces lying in var amounts of connective tissue The tumors

not truly encapsulated but may be surrounded by a moderate fibrous overgrowth

Treatment. Irradiation gives the best results with angiomas. Beta irradiation is especially applicable for the beta rays have the same power of selective tissue destruction as do the gamma rays, but they penetrate only about three millimeters of tissue This makes them ideally suited to treatment of the lids and of the anterior ocular segment.

Two types of beta applicators may be used

1 A radon applicator designed by Dr Curtis F Burnam has been used in the Wilmer Clinic for the past thirteen years It consists of a 5 millimeter soda glass bulb containing 200–500 millicuries of radon, enclosed in a brass cylinder with walls 2 millimeters thick. From a 4 millimeter window at one end of the applicator beta and gamma rays pass unfiltered, the alpha rays being stopped by the soda glass container The high proportion of beta rays (100–1) to gamma rays, and the short treatment time required, make the unfiltered radon the ideal applicator (Fig 388)

Dosage with this applicator in contact with the lesion is four to five gram seconds in adults in children two to three gram seconds since their reaction to irradiation is much greater than that of adults. Other clinics use milligram-hours rather than gram seconds the conversion being made by multiplying the gram seconds time by 0.277 Thus five gram-seconds is equivalent to 1.385 milligram hours

The therapy for angioma should not be hurried four to six weeks at least should be the interval between treatments.

2 A radium plaque applicator (Fig 389 A and B) designed by Iliff gives equally good results but requires longer treatment time This consists of a five by ten millimeter rectangular fifty milligram radium plaque with a 0 1 millimeter monel face plate To obtain an equivalent of the five gram-seconds dose from the radon applicator which takes ten to twenty five seconds depending on the strength of the applicator ten minutes treatment time is required This is because the beta output is a surface fire in the radium applicator, in distinction to the point source fire of the radon applicator Filtration in the radium applicator consists of the 0 1 millimeter monel filter and the layering of the

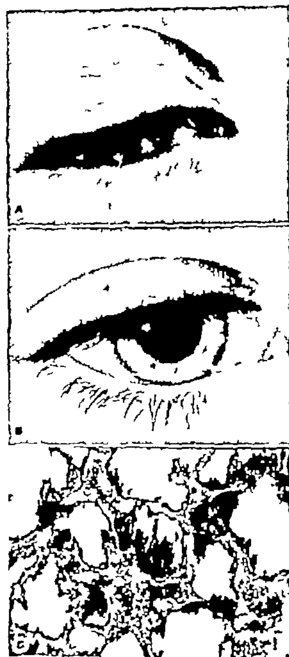


Fig 387
A. Cavernous Hemangioma upper lid
B Cavernous Hemangioma upper lid after 17 gm. seconds contact, Beta irradiation
C Photomicrograph.

radium salt itself Therefore, the fifty milligrams are actually the equivalent of thirty milligrams. Thus in radon and radium applicators of equivalent strength the radon delivers about four times the beta output per unit area. With the radium applicator larger surfaces can

be treated somewhat more easily but the greater time factor makes it less desirable

In treating lid angiomas with beta irradiation, it is advisable to treat both the skin and the conjunctival surface when the lid can be

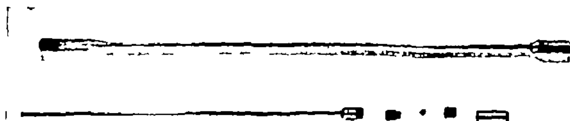


Fig 388. Burnam Radon applicator For Beta Irradiation of eye and adnexa

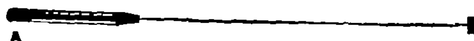


Fig 389
A. Iliff radium plaque applicator—for Beta Irradiation of lids.



Fig 389
B Radium plaque applicator in holder for treatment of lid lesions.

satisfactorily turned to expose the conjunctival side of the tumor

Soft x rays, using low voltage and fractionated dosage likewise obtain desired results With this method the globe should be protected against the possibility of an irradiation cataract by a one-millimeter thickness of lead lid shield

Capillary hemangiomas are destroyed very rapidly by the low total dosage of five to fifteen gram-seconds of contact therapy

Cavernous hemangiomas respond equally well but much more slowly and a higher dosage varying with the size and location of the lesion may be necessary

No cataract resulted from the use of the Burnam applicator during the ten-year period of clinical observation in this series, even when patients were given for some conditions of the lids divided dosage totaling as high as two hundred gram-seconds of beta irradiation.

Comment. Irradiation is preferred to surgery sclerosing fluids or carbon dioxide snow for angioma of the lids because in most cases it gives better cosmetic and functional results.

NEUROFIBROMAS OR PLEXIFORM NEUROMAS

(5 Cases) These benign congenital tumors of the lids are associated with neurofibromas of the cornea iris ciliary body retina choroid or orbit or with the generalized disease of Von Recklinghausen Developmental defects in the orbital or temporal bones frequently occur and are accompanied by irregularities in the shaft of the long bones and sclerosis of the spine *Cafe au lait spots over the torso* are diagnostic when found in association with the tumors. The tumors are usually noted in early childhood but growth is quite slow and aid is not sought until

the cosmetic or functional defect has become quite marked The temporal portion of the upper lid is first involved becoming partially ptosed diffusely thickened and somewhat oedematous The overlying skin is darker and hairier than normal skin Corded strands in a rather loose matrix form the tumor tissue and these, on palpation, give one an impression of a 'bag of worms' (Fig 390 A and B) Smaller multiple discrete lid nodules similar to typical skin involvement in Von Recklinghausen's disease do occur but are unusual (Wallack)

Differential Diagnosis. The single entity in itself may be confused with angiomas or dermoids. On diligent search though associated defects can usually be found to confirm the diagnosis Large neurofibromas offer no problem in diagnosis.

Pathology The fibroblast is the typical cell of the neurofibroma and is derived from the sheath of Schwann Cords of these cells characterized by hyalin whirls, lie in a tangled matrix of nerve fibre elements

Treatment. Neurofibromas are not radiosensitive Complete surgical removal as early as possible is essential since the slow recurrence of inadequately removed neurofibromas or the extensive involvement of all orbital structures in long-standing cases becomes a major surgical problem.

General anesthesia is necessary as the lesions are usually more extensive than they appear Bleeding is profuse and it may be necessary to give intravenous fluids or plasma at time of operation The extent of the operative procedure depends on the individual case In working with the lids great care should be taken not to injure the levator In most cases a ptosis is the presenting complaint. It is usually wise to do a Blascovicz type operation which shortens the levator at the time the tumor is removed Excision of the thickened pigmented and hairy skin that overlies extensive tumors makes much better closure

Tumors that invade the temporal fossa in addition to the lids should be approached through a temporal post hairline incision to avoid great scarring

In some instances repeated small surgical removals keep the growth in check, when the tumor can not be completely removed at the initial procedure.



Fig 390

A. Neurofibroma of lateral half of upper lid and temporal fossa.
B Postoperative neurofibroma of upper lid and temporal fossa.

Benign Tumors of the Lid in Adult Life

PAPILLOMAS

(44 Cases) Papillomas of the lids are extremely common benign tumors appearing in the older age groups and particularly in the fifth and sixth decades In 75 per cent of our series of forty four cases, the papilloma was located on the lower lid or at the inner canthus. The majority were at the muco-cutaneous junction Papillomas may be single or multiple and may show a variety of form ranging from a flat mulberry type to a long pedunculated tumor with frond like processes (Fig 391 A and B)

The consistency of the papilloma may be soft and friable but the base of the larger tumors has a rubbery quality which makes it difficult

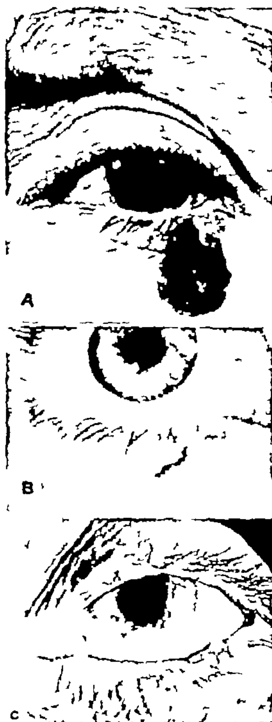


Fig 391

A Benign papilloma partially necrotic
B Benign papilloma, mulberry type lower lid.
C Papilloma mucocutaneous margin

to differentiate them from some of the early carcinomas Occasionally pigment is seen in the *deeper layers of the base Some of the tumors* outgrow their blood supply causing distal necrosis with crusting and secondary infection (Fig 391 C) Bleeding from the necrotic area is common

Differential Diagnosis. Papillomas must be *differentiated from*

(1) Carcinomas which are hard less circumscribed and in the later stages destructive (Pg 502)

(2) Sarcomas which vary in pigmentation. (Pg 513)

(3) Nevi which are firm congenital tumors. (Pg. 493)



Fig. 392. Molluscum contagiosum on the cutaneous lid margin.

(4) Cornus cutaneum which are small horny avascular epithelial overgrowths usually not lobulated (Pg 501)

(5) Molluscum Contagiosum which is characterized by nodular elevations with central depression and waxy appearance situated along the cilia line of the lid (Fig 392) The cause is thought to be a virus. Pathologically the cells have a peculiar appearance with the so-called molluscum bodies in a reticulated cytoplasm imperfectly separated from the nucleus and cell members.

However obvious the clinical diagnosis may be the only sure method of diagnosis is by biopsy

Pathology Papillomas consist of a vascular fibrous stalk covered by normal squamous epithelium

Treatment. Surgery is the most expeditious *and satisfactory method* The base of the papil

loma is injected with 2 per cent procaine and the tumor simply excised Bleeding points are touched with the hand cautery Treatment of the base with three gram seconds of beta irradiation at time of operation is especially useful for avoiding recurrences However if the patient objects to surgery beta irradiation alone is equally satisfactory and gives excellent cosmetic results. The base of the tumor then is given five gram-seconds of contact therapy, from one two or three angles, depending on size The blood supply is hereby occluded and the tumor sloughs off When papillomas are



Fig. 393 Chronic granulation tissue at lid margin following a chalazion or hordeolum.

located at or near the puncta irradiation can be used to advantage without damaging the lacrimal passages.

CORNUA CUTANEUM

(3 Cases) These are benign horny overgrowths of the epithelium. They are usually found in older patients. In this series the three patients were over sixty The lesion itself consists of a scaly greyish excrescence on the lid margin and may have small blood vessels coursing its surface (Fig 394)

Differential Diagnosis. The size and location of these tumors may cause them to be confused with papillomas (Pg 499)

Pathology The prickle cells become horny and do not shed, thereby piling up columns of horny cells. Hair follicles and sweat glands take part in this proliferation

Treatment. Simple excision satisfactorily removes these tumors, though they are apt to recur The addition of three gram seconds of beta irradiation in contact with the base will prevent recurrence.

XANTHOMAS

(1 Case) Xanthomas are benign tumors of the lid While one case only is included in this



Fig 394. Cornu cutaneum upper lid



Fig. 395 Xanthoma upper lid inner angle

series, they occur frequently Clinical diagnosis is so obvious that biopsies are rarely taken Xanthomas appear most frequently in older women and are slow in enlarging The only reason for their removal is the cosmetic blemish The tumors are of pale yellow to brownish color and project slightly above the level of the normal skin. Frequently they are found in the neighborhood of the inner angle, often symmetrically placed on both upper lids (Fig 395)

Differential Diagnosis. Occasionally, a very small xanthoma may be confused with a small sebaceous cyst.

Pathology *The xanthoma is composed of* both large swollen polyhedral and smaller spindle-shaped cells containing fatty globules There has been some dispute as to the origin of these cells. Unna traces a close connection between the fatty cells of early xanthoma and the orbicularis muscle fibre Kraupa states that any recurrence after local skin removal is caused by the involvement of the orbicularis muscle He advises removal of the subcutaneous muscle at the time of operation

Treatment. Sclerosing fluids electric needle, and irradiation have all been used in the treatment of xanthoma, but are not as satisfactory as surgical removal which is simple and faster and which gives better cosmetic result The subcutaneous tissue is infiltrated with 2 per cent procaine to which a couple of drops of adrenalin have been added to reduce bleeding The skin is put on stretch by finger traction and two elliptical skin incisions are made with a small Bard Parker knife to outline the tumor so that the skin may be closed in a single suture line The skin around the xanthoma is usually relaxed and undermining should effect easy closure even when the tumor is of good size

Uncommon Benign Tumors of the Lid

ADENOMAS

(0 Cases) Adenomas are rare tumors of the sweat sebaceous or Meibomian glands or the glands of Moll Clinically the adenoma may be confused with a chalazion and the diagnosis depends on a pathological section

LIPOMAS

(0 Cases) Lipomas of the lids usually occur as secondary to extensions from the orbit

GLOMUS

(0 Cases) Kirby reported removal of a small firm circumscribed mass from the mid portion of the lid which proved to be a neuromyo-arterial glomus characteristically found in the skin of the fingers This is the only reported case

MYXOMAS

(0 Cases) Myxomas are composed of mucinous tissue and are supposedly embryonal. Town has reported one as a soft pink friable mass surrounding the lower puncta It was benign and did not recur after complete surgical removal

TRICHO-EPITHELIOMAS

(0 Cases) Benign non ulcerating these are slow-growing tumors with a few hairs of very fine texture projecting from the surface. Keyes and Queen have reported the case of a young soldier who had a tricho-epithelioma on the lid margin

Differential Diagnosis. Fine, sparse hairs are probably the chief diagnostic feature of this tumor

Pathology A few partially developed hair stalks as well as sebaceous glands and ducts of sweat glands occur with irregular palisading of the basal cells.

Treatment. Simple surgical removal is indicated There is a tendency to recur if incompletely removed

MALIGNANT TUMORS OF THE LID

CARCINOMAS BASAL CELL

(33 Cases) The incidence of these most common malignant tumors of the lids is slightly greater in men and the average age is in the sixth decade although the youngest patient in this series was a woman of twenty

Early the tumor is a characteristically hard nodule beneath the skin two to six millimeters from the lid margin (Fig 396 A) The skin over the tumor may be scaly and present multiple telangiectases Three fourths of our cases were found either on the lower lid or at the inner canthus (Fig 396 A B and C) When the tumor breaks down the edge is hard nodular elevated and undercut and the areas of healing may be closely associated with the areas of invasion The base is crusted and weeping and when the crusts are removed bleeding points

occur As the lesion progresses, there is a marked tissue loss as the growth invades the orbit or the sinuses. Involvement of the regional lymph nodes and metastases rarely occur, but when they do they develop late

Of the thirty three patients in this series the majority had been aware of the lid lesion for a year or longer before appearing at the clinic. Postoperative follow up was possible with only twenty-one of these

In fifteen the tumor, when first seen was still confined to the lid and surgical excision as a primary procedure gave an excellent result There was opportunity to follow ten of these cases for one year two for three years, and three for four years, and during these periods no recurrences were noted

In six cases the tumor when first seen had already extended into the sinuses (Fig 396 C) and exenteration together with extensive sinus surgery did not effect a cure Irradiation used after surgery held the growth in check but did not completely eradicate it. One patient died in four months, one in three years, and one in six years. One patient is still living eight years after exenteration and irradiation one three years and one four years but in all three the tumor is still present

Ten to twenty years of follow up with residual tumor is not uncommon, as is shown in several other cases not included in this series. It is difficult to understand how the patient can continue alive in these long standing cases where there is such great loss of tissue

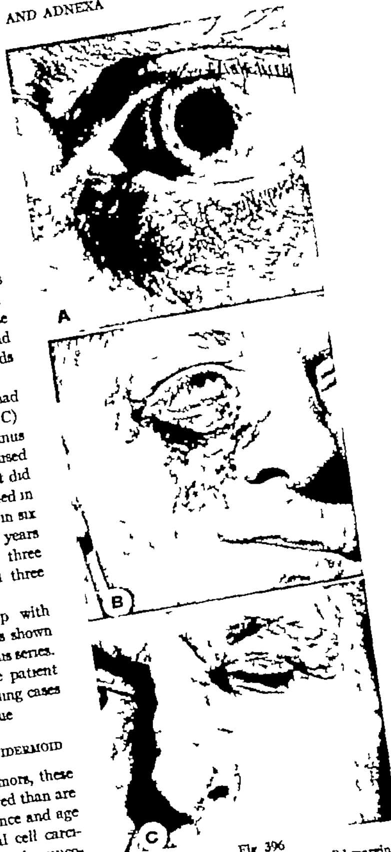


Fig 396

A. Basal cell carcinoma 4 mm. from lid margin.
B Basal cell carcinoma extensive of lower lid and cheek
C Basal cell carcinoma of inner canthus—with invasion of ethmoids.

CARCINOMAS SQUAMOUS CELL OR EPIDERMOID

(7 Cases) Very malignant lid tumors, these are fortunately less often encountered than are basal cell carcinomas Their incidence and age group correspond to that of basal cell carcinomas. Typically these are found at the mucocutaneous margin of the lids. Stony hard they ulcerate early presenting a raised edge and a grey crusted base. Removal of crust causes bleeding points (Fig 397) In contrast to those of the basal cell carcinoma extension to the regional lymph nodes and metastases are early

Five of these patients were men two were women, the majority were in their sixties. In four the carcinoma was in the lower lid in one,

at the inner canthus. One had upper lid involvement The seventh had a lesion so extensive that its origin could not be determined Two of the patients already had metastases when they came to the clinic and they died within a year's time Three with the lesion at the outer third of the lower lid, were surgically treated They have been followed, respectively one two and five years and there has been no

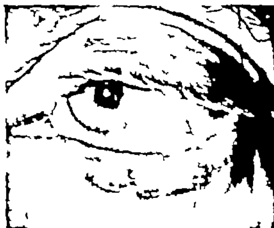


Fig 397 Squamous cell carcinoma lower lid



Fig 398 Chronic chalazion may be confused with basal cell carcinoma.

recurrence The remaining two cases had an extensive local invasion Exenterations were done and then postoperative x ray given One has been followed for a period of three years, with no recurrence evident The other could not be followed

Prognosis. Prognosis of squamous cell carcinoma is poor because of early metastases.

Differential Diagnosis. Biopsy is essential to absolute diagnosis for any of the following tumors

(1) Basal cell carcinomas more frequently originate three to four millimeters away from the lid margin, squamous cell carcinom acteristically originate at the muco-cu junction Both are hard and locally in The basal-cell type does not usually m size or invade the lymph glands. In c the squamous-cell carcinoma metastasi spreads into the regional lymph gland early stage

(2) Basal cell carcinomas may be c with Chalazions (Fig 385 398) Differe the wary excrescence on the lid margin mouth of the gland itself is a diagnostic a chalazion, as pointed out by Holland Krugh



Fig. 399 Gumma of tarsus may be confu squamous cell carcinoma.

(3) *Papillomas located back from the cutaneous margin may occasionally re* basal cell carcinomas, but are more ofte fused with the squamous cell type (Pg

(4) Gumma of the tarsus before br down can be easily confused with a ba carcinoma. After breaking down (Fig 39 ulcerating it is quite like the squamo carcinoma but the base is cleaner A gu not as firm in consistency and has a softe than either type of carcinoma It re rapidly to anti syphilitic therapy

(5) The nevus does not have the hard early carcinoma and usually occurs younger age group. It does not invade or ate (Pg 493)

Pathology Basal cell carcinomas of th present a typical picture bulks ma darkly-stained polyhedral cells with lar clei in a small amount of cytoplasm and

defined cell outlines. Invasion laterally beneath the epidermis is characteristic.

Squamous cell *carcinomas* are made up of masses of cells growing down into the dermis with typical epithelial pearl arrangement. Frequently the stroma is infiltrated with inflammatory cells as the result of secondary infection

Treatment. Choice of therapy for carcinomas of the eyelids depends on the site and extent of the lesion and the condition of the patient. Complete and immediate eradication with the best functional and cosmetic result is the goal. If the tumor is located on the lateral or middle portion of the upper or lower lid and the patient is in otherwise good condition, the *surgical removal of the tumor is the most expe*ditious method and in the hands of an experienced ophthalmic surgeon gives excellent functional and cosmetic results. If the lesion involves the nasal portion of the lids (Fig 400 A and B), that at the puncta or at the inner canthus irradiation should be used (Fig 396 C)

X ray or interstitial radiation therapy gives excellent results in trained hands and is better adapted to therapy around the inner canthus. In this area the skin is less easily used for sliding flaps and the base is not as satisfactory for free grafts Tube grafts in the region of the eye *are definitely inferior to other forms of grafts* and should not be used

Surgery of Malignant Tumors—Lower Lid. The size of the lesion determines the surgical procedure. Small tumors situated at the lid margin or two or three millimeters away from it should be removed with an adequate margin of two or three *millimeters by using a simple V* incision. In older people this is facilitated by the natural relaxation of the lids.

Technique The lid is put on stretch by a traction suture through the tumor area to be removed or by the use of a small-toothed forceps, with the bite taken on the skin and conjunctival surface A silver globe shield or spoon spatula is placed beneath the stretched lid to protect the globe The legs of the V are cut in an elliptical manner with a small Bard-Parker scalpel (Fig 401 A) A traction suture is passed vertically through the lid margins to test ease of approximation and to give perfect alignment in suturing If the cut edges can be approximated without undue tension, two five-zero plain catgut sutures, placed so the knots are buried, are used to close the conjunctival surface of the lid and the tarsus. The skin is closed with a fine dermalon suture, interrupted and closely spaced. The elliptical shape of the triangle or V legs makes a slight peak at the lid

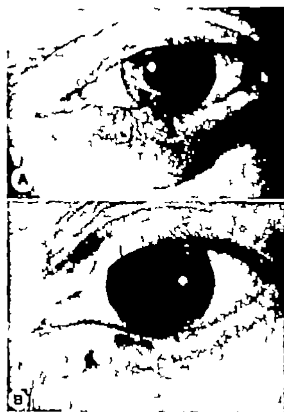


Fig 400

A. Basal cell carcinoma lower lid, nasal one-third (before treatment)

B Basal cell carcinoma of lid (after contact Beta Irradiation therapy)

margin which as scar contraction takes place, becomes a smooth, curved contour (Fig 401 B)

If the closure of the lid defect is not possible without undue tension a relaxation triangle can be made temporally An incision is made for two centimeters extending laterally and slightly upward from the lateral canthus, a one centimeter relaxation triangle of skin is removed above and the skin undermined in the shaded area (Fig 402 A) The realignment

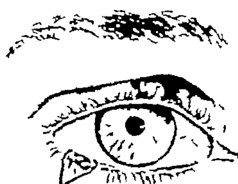
made possible by this undermining and the removal of the relaxation triangle gives closure without tension (Fig 402 B C and D)

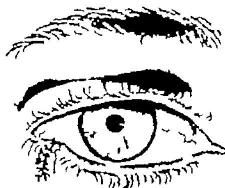
Individual differences in cases require many varieties of this simple relaxing procedure

When the tumor is not at the lid margin a block dissection with rectangular sliding flap is more practical Two relaxation triangles are required. Occasionally the conjunctiva can be saved but in most cases a full thickness removal is the safest (Fig 403 A and B and C)

Marginal tumors of the squamous cell type often are relatively extensive along the lid

junctiva and tarsus as far nasally as the def in the lower lid has extended. A cut is th made with scissors through the conjunct and tarsus at the nasal edge of the pock freeing the apex of a triangle of tarsus a conjunctiva (Fig 405 B) A suture is placed this apex and the triangle is swung downwa and sutured into place to fill the defect in t lower lid (Fig 405 C) This part of the pro dure is a typical lateral Elschnig tarsorrhaph A tongue of skin one third larger than t lower lid defect, is then freed from the upp lid fold, and an attachment temporal to t





A

B

Farreyhorgh 49

Fig. 401

A Simple resection of small lid tumor
B Closure of elliptical incisions to give peak at lid margin

margin yet very shallow Here a classical lunate excision preserves more of the cul-de sac and gives better function than the V incision. A temporary lateral tarsorrhaphy for four to six weeks gives upward support to the new lower lid segment until contours are established (Fig 404 A and B)

Alternate procedure employing a tongue of skin and orbicularis muscle from the upper lid fold to fill the defect gives a satisfactory result The tumor is excised from the lower lid and bleeding points either tied or cauterized (Fig 405 A) Next the upper lid is everted and an intermarginal incision made to free the con

lateral canthus is maintained With the sk flap mobilized it is then possible to free a pie of the orbicularis muscle swing it below ar leave the same lateral attachment

The muscle when sutured with five-ze plain catgut to the lateral portion of the r maining lower lid lies anterior to the conjun tiva and tarsus which were swung down fro above With interrupted stitches of fine derm lon the skin is then carefully sutured to th defect (Fig 405 D) It is important that the sutures take only a very small bite to avoid rolling or buckling the skin The defect in the skin of the upper lid may be closed with a

running subcuticular stitch of dermalon since there is no tension on the suture line The tarsorrhaphy should be left closed for six weeks and then opened

To fill the defect of the lateral half of the upper lid (Fig 406 A) the lower lid is split along the intermarginal line and the lateral conjunctiva and tarsus mobilized and swung

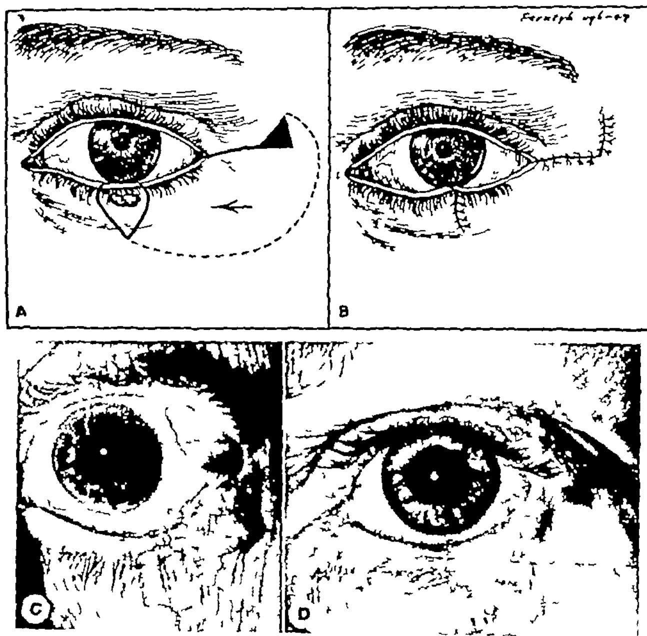


Fig. 402
A. Resection of basal cell carcinoma of lid undermining skin in shaded area.
B Relaxation triangle above
C Basal cell carcinoma outer third lower lid
D Cosmetic result after surgical excision and plastic closure no recurrence.

Surgery of the Upper Lid The plentiful skin of the upper lid supplies sliding flaps for partial resection and makes this procedure less difficult than that on the lower lid The loss of all the tarsus does not necessarily impair the function as has previously been believed

upward (Fig 406 B) Five zero catgut sutures are used to fasten the conjunctiva and tarsus to the levator and also to the cut tarsus of the upper lid (Fig 406 C) The skin and orbicularis are then mobilized from above and swung down to fill the skin defect, using a nasal relaxation

triangle (Fig 406 C and D and E) To make a temporary tarsorrhaphy and prevent early contracture the skin margin is sutured to the lower lid This is opened in six weeks time

The almost complete resection of the upper lid as described by Dr John McLean gives excellent functional and cosmetic results, block dissection is done of almost the whole u

Fig 403
A and B. Block resection of basal cell carcinoma using two relaxation triangles. Undermining in shaded ar
C Postoperative 6 months after block dissection

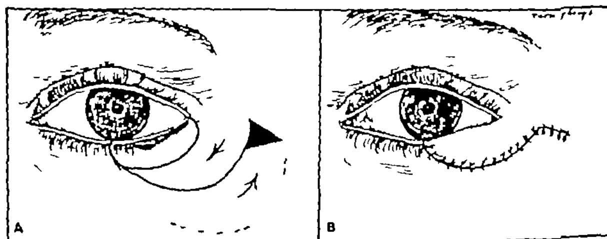


Fig 404
A and B Resection of shallow marginal tumor

per lid (Fig 407 A) After the levator is isolat and secured the lower lid is split and the tars and the conjunctiva stretched upward a sutured to the levator (Fig 407 B) A strip

orbicularis is isolated from above and swung down over the new formed tarsal plate Lateral relaxation triangles permit a skin flap to be brought down from above and sutured to the denuded border of the lower lid (Fig 407 C) The incisions are closed with fine silk Eight weeks later the tarsorrhaphy is opened and tients Mohs used a microscopically controlled chemosurgery technique and obtained equally satisfactory results.

Hollander and Krugh used contact x ray Chaoul tube with a focal distance of 3.5 centimeter, filter 0.5 nickel, 500 r daily for ten to twenty treatments with a total dosage between

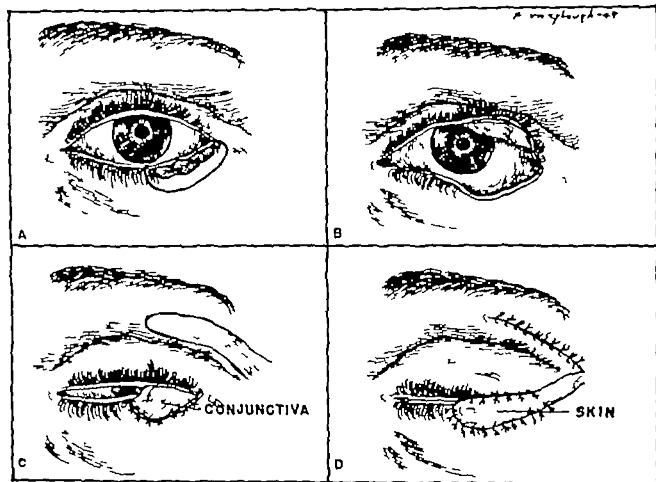


Fig. 408

A Resection of marginal tumor
B Upper lid split and conjunctiva and tarsus freed to fill defect below
C Defect filled with conjunctiva and tarsus from above—sutured in place with catgut. Tongue of skin freed from upper lid fold.
D Skin and Orbicularis muscle swung down to fill lower lid defect.

lashes grafted and an excellent result is obtained (Fig 407 D and E)

Irradiation Treatment. Hollander and Krugh in a survey of 125 cases of lid carcinomas report obtaining equally good results with surgery or with x ray treatment Hunt obtained excellent results with x ray alone reporting only four failures among one hundred cases. Charteris, using interstitial radium needle implants, obtained cures in sixty-eight of seventy-six pa 5 000 and 10 000 r They had twelve good results in seventeen patients treated with the above method.

Hunt used contact fractionated x ray giving 5000 to 8000 r total in five treatments, administered over five to twenty-one days, for the smaller the area, the longer is the time allowed between treatments. In small lesions of ten down to five millimeters in size, the amount must be increased ten to fifty per cent to get

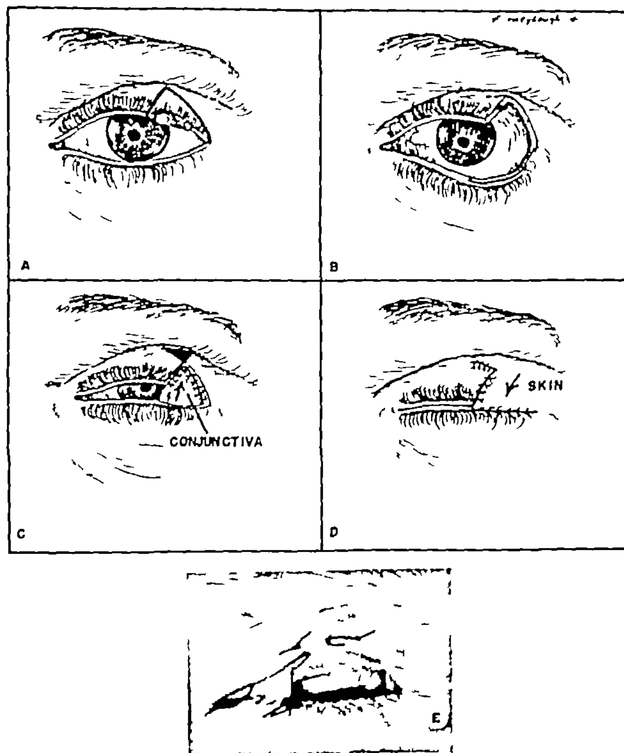


Fig 40[?]

A Resection of tumor upper lid lateral half
B Lower lid split to supply tarsus and conjunctiva for defect above
C Relaxation triangle nasally in skin
D Skin and orbicularis swung down to fill defect
E Case two days postoperatively

dosage comparable to that developed in lesions of twenty to thirty millimeters in size The recommended KV peak with small lesions was 70 KV 90 KV for lesions three to four millimeters thick 140 KV with 0 25 millimeters of copper and 0 10 millimeters of aluminum for

larger lesions, 200 KV with 0.5 millimeters of copper for orbital and larger lesions Hunt or more beyond the obvious border of the lesion, and the lens and globe should be pro-

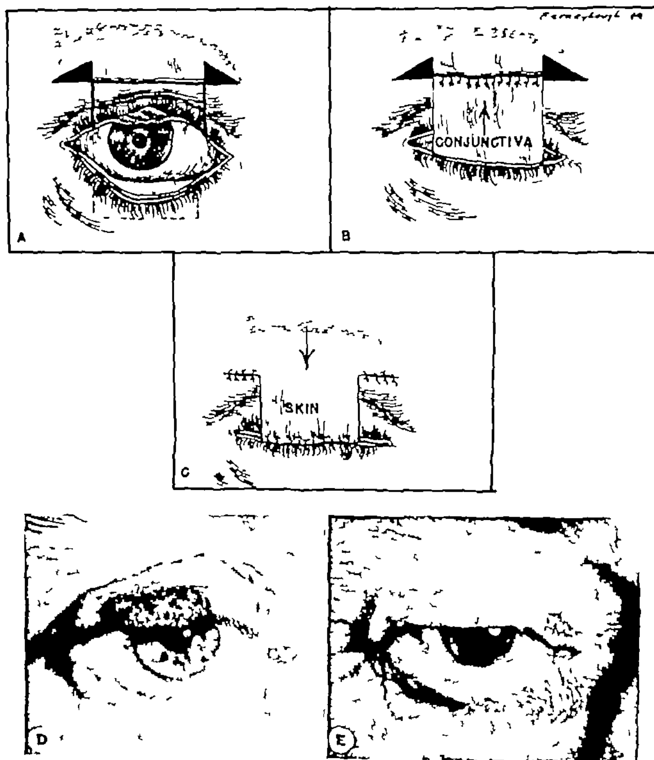


Fig. 407

A, B and C Resection of section of upper lid according to technique of McLean

D and E. Melanoma of upper lid—original case of Dr John McLean pre and postoperative.

found the scars from such doses less atrophic than from a single large dose Irradiation treatment should always extend three millimeters tected by using a one millimeter lead shield. The use of interstitial radium should be reserved for recurrent or persistent subcutaneous

lesions intra-orbital or deep infiltration or non-resectable metastatic regional nodes Charteris obtained excellent results using radon seeds, or needles He used needles 27 7 millimeters long with an active length of 16.2 millimeters These were filtered with 0.5 millimeters of platinum and the seeds contained from 1 0 to 1.2 millicuries each They were placed interstitially not less than one centimeter apart and left in place for 168 hours giving an average dose of 5000 to 6000 r and in some cases one as high as 8000 r

Dangers of Irradiation Irradiation cataracts Irradiation cataracts are posterior subcapsular cortical opacities seen first as small disturbances at the equator of the lens and characteristically develop late some two years or more after irradiation Microscopically the opacities occur from the generation of abnormal and shorter lens fibers, following the injury of the subcapsular epithelial cells along the anterior aspect of the lens.

Radiation of the lid lesions necessitates the passing of rays in an A P direction which if not properly shielded is dangerous to the lens and anterior segment *Adequate shielding cannot be overstressed* A list of cataracts with their reported dosage follows

Schulz & Heath	1200 r through center of cornea	—Cataract	5 years
Hunt	*875 r 130 KV 1 mm of aluminum*	— "	*5 years*
"	6 doses—800 r to lower lid	— "	2 years
	2400 r to lower lid	— "	6 months
	1500 r to lower lid	— "	8 years
"	1350 r or (900 milligram hours radium)	— "	5 years

Since the anterior segment is extremely radio-sensitive Reese and Martin in their article on retinoblastomas stress the importance of the proper direction of the rays The posterior segments in their series received 16 000 r without difficulty whereas very small dosage to anterior segment produces cataract or secondary glaucoma with ultimate phthisis.

PAPILLARY CARCINOMAS

(1 Case) Papillary carcinomas of the lid occur in the older age groups. The patient of this series was a white man sixty-eight years old who had noticed for ten years a roughness of the right upper lid with a thickening of the skin in this area Suddenly this growth started to enlarge and became grey and keratinized The skin with a rubbery feel like that of elephant hide overhung the lid margins and obliterated the crease (Fig 408 A and B) Clinically the picture resembled a senile keratosis (Fig 409 A and B)

Pathology The cells had a papillary arrangement and a few mitotic figures were present

Differential Diagnosis. Papillary carcinomas greatly resemble senile keratosis, and one case of blastomycosis (Fig 410) was also similar in appearance to these tumors.

Treatment The lesion was too extensive to remove surgically so was given two ten-minute applications to each area of beta irradiation using a 50 milligram radium plaque in contact with the lid The growth completely disappeared without any recurrence There has been a follow up of two and one-half years to date

SARCOMAS

(1 Case) Sarcomas of the lids are classified according to the predominate cell type round cell, spindle cell, mixed cell myo- myxo- fibro- angio- and rhabdomyo The malignancy of this group is quite variable In children lid involvement is usually associated with that of the orbit and here the malignancy is extreme On the other hand some of the sarcomas in adults are of rather low grade malignancy One case of an angiosarcoma not included in this series but seen in Wilmer Clinic twelve years ago was locally removed and had the clinical appearance of a term angioma On section however it showed definite invasive tendencies of the endothelioma A follow up could not be

continued after two years but the local removal had apparently been adequate for there was no recurrence during that time

Kaposi disease is a multiple idiopathic hemorrhagic sarcoma which has been reported in the eyelids. The structure of the eyelid nodules resembles that of a capillary angioma or a cavernous angioma. Hemorrhage and pigmentation are constant findings but the lesions may resemble the sarcoids of the skin as de-

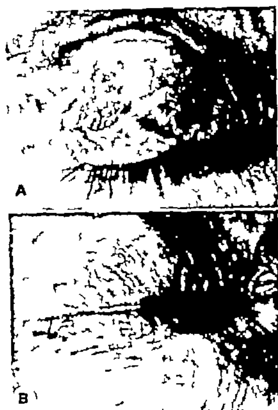


Fig 408

A. Papillary carcinoma upper lid

B Papillary carcinoma upper lid after contact Beta irradiation

scribed by Boeck Localized small lesions are said to respond well to x ray or radium

In this series there was only one sarcoma This was a malignant melanosarcoma in a man of seventy two years which consisted of a black fungating mass with a broad pedicle involving the central portion of the upper lid There was a history of rapid growth in what had appeared to be a benign mole first noted fifteen years earlier The mass in the center of the upper lid showed some crusting and was obviously partially necrotic This tumor was completely removed by a wide excision according to the technique described by McLean (Surgery of Upper Lid Pg 507)



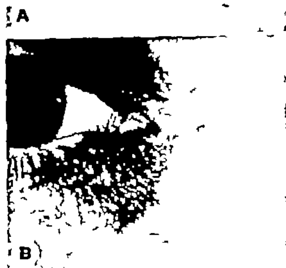


Fig 409

A Senile hyperkeratosis at inner canthus.

B Senile hyperkeratosis after irradiation therapy



Fig 410. Blastomycosis, lower lid to be differentiated from papillary carcinoma

Strough reports a sarcoma in a negro which involved the lid and conjunctiva This was removed surgically and the eye enucleated Four years later there was still no sign of recur

rence That this patient was a negro was unusual. For instance of thirteen hundred and eighty five melanomas in the Army Medical Museum records, only eight two of which were conjunctival and six uveal, were in negroes.

Pathology As elsewhere in the skin sarcomas may show a variety of cell types—spindle fibroblastic, and those of specialized tissue as the angiosarcoma and neuro-fibrosarcoma Tumors with undifferentiated cell structure and low reticulum count are more malignant



Fig 411 Sarcoid nodules of lid and face

Treatment. Angio- myxo- and rhabdomyosarcoma are radio-sensitive Melano- neuro- and fibrosarcomas are radio-resistant In all these initial surgery should be radical and irradiation should be used as an adjunct to the surgery

Generalized Diseases with Associated Tumors of the Lid

LYMPHOMAS

(2 Cases) These nodules of lymphoid like tissue are found evenly placed in the lids and classed according to the predominating cel type One case in our series was in a woman o twenty six who had noted for a period of thre months bilateral nodules the size of lima bean in the upper lids. Except for a chronic cold an a postnasal drip she had been well On exami nation she was found to have a general glandu lar enlargement and a white blood count o sixty four thousand In the blood smear wer great numbers of young lymphocytes and a few lymphoblasts. Biopsy proved the tumo masses to be lymphoid nodules with young cell and mitotic figures, and the diagnosis wa *lympho-sarcoma* X ray therapy to the lids and to the regional lymph and mediastina glands caused a prompt disappearance of the tumor masses. A follow up was not possible but the prognosis was extremely poor Galla port reports a case of similar bilateral lesions in a child who died in four months time McGavic stresses the fact that biopsy is ofter confusing as lymphoid tissue taken from differ ent parts of the body in the same patient presents different invasive stages and makes identical pictures impossible

Treatment. McGavic reports that eleven of the seventeen primary lymphoid tumors of the adnexa did not recur after x ray therapy Martin feels that lymphomas and lympho-sarcomas *in the region of the head and neck should* be treated as local single lesions such as primary tumors of the tonsils. He recommends *the same irradiation therapy* that is used for retinoblastomas.

SARCOID

(1 Case) A generalized systemic disease it typically affects the eye and ocular adnexa i e the lids the conjunctiva extra-ocular muscles and orbital tissues. Anterior uveitis, and less commonly choroiditis may also occur (Woods)

The lid lesions (Fig 411) are simultaneously associated with other lesions of the skin and there may be general glandular enlargement X rays may show mediastinal enlargement and cystic changes in the long bones of the hands

and feet Anergy to tuberculin is present in fifty p r cent of the cases.

These lid tumors consist of sharply circum scribed nodules, deeply situated in the skin which elevate the epidermis The nodules do not break down often they disappear promptly although some may last for years.

present Ultra violet light treatment of the whole body may possibly be beneficial

TUMORS OF THE CONJUNCTIVA AND CORNEA

Tumors of the conjunctiva and cornea will be discussed together as a great many of them

TABLE 30

Differential Diagnosis, Common Primary Malignant Lid Tumors

	AGE	RATE OF GROWTH	LOCATION	APPEARANCE	DEGREE OF MALIGNANCY	TREATMENT
Carcinoma basal cell	Adult 20–80 most fre quent 40–60	Slow	Most common lower lid or at inner can thus 2–6 mm. away from lid margin	Hard overlying skin scaly with telangiectasis when breaks down hard edge under cut bleed ing points—base	Local extension metastases rare Lymph nodes rarely involved.	Surgery and irradiation (see text)
Carcinoma squamous cell	Adults 20–80	Moderate ly rapid	Typically at mucocuta neous junc tion	Hard-elevated edge ulcerated base. Weep se rous fluid. Re moval of crust leaves bleeding points.	Metastases early and distantly to lymph glands	Surgery and irradiation
Papillary carcinoma	Adults 20–80	Slow	Diffusely in volving lids	Keratotic rough ened grey thick ening of skin resembling rub bery elephant hide	Superficial low malignancy does not usually metastasize	Surgery and irradiation
Sarcoma	Any age	Slow or rapid	May be associ ated with orbital lesion	Hard—may or may not be pig mented rapid growth. Biopsy only sure diag nosis	Usually locally invasive and of variable degrees of malignancy and metastatic characteristics.	Surgery and irradiation
Lymphoma	Usually adults	Usually rapid	Mass in upper or lower lid may be bi lateral	Masses almond shaped, moder ately firm	Associated usually with generalized glandular in volvement.	Irradiation

Pathology Hard tubercles without caseation made up of epithelioid cells with an occasional giant cell and a ring of leucocytes are the typical picture Giant cells sometimes contain doubly refractile bodies (Shaumann bodies)

Treatment. No specific therapy is known at

arise at or close to the limbus and involve both. As in tumors of the lids benign dermoids, nevi and angiomas are found occurring in childhood with no malignant tumors in this series. On the other hand, in adult life malignant tumors are as common as the benign In deciding

rence That this patient was a negro was un usual For instance, of thirteen hundred and eighty five melanomas in the Army Medical Museum records, only eight two of which were conjunctival and six uveal, were in negroes

Pathology As elsewhere in the skin sar comas may show a variety of cell types—spindle fibroblastic, and those of specialized tissue as *the angiosarcoma and neuro-fibro-sarcoma* Tumors with undifferentiated cell structure and low reticulum count are more malignant



Fig. 411 Sarcoid nodules of lid and face

Treatment *Angio- myxo- and rhabdomyo-sarcoma* are radio-sensitive Melano- neuro- and fibrosarcomas are radio-resistant In all these initial surgery should be radical and irra diation should be used as an adjunct to the surgery

Generalized Diseases with Associated Tumors of the Lid

LYMPHOMAS

(2 Cases) These nodules of lymphoid like tissue are found evenly placed in the lids and classed according to the predominating cell type One case in our series was in a woman of twenty six who had noted for a period of three months bilateral nodules the size of lima beans in the upper lids. Except for a chronic cold and a postnasal drip she had been well On exami nation she was found to have a general glandu lar enlargement and a white blood count of sixty *four thousand. In the blood smear* were great numbers of young lymphocytes and a few lymphoblasts Biopsy proved the tumor masses to be lymphoid nodules with young cells and mitotic figures, and the diagnosis was lympho-sarcoma X ray therapy to the lids and to the regional lymph and mediastinal glands caused a prompt disappearance of the tumor masses A follow up was not possible but the prognosis was extremely poor Galla port reports a case of similar bilateral lesions in a child who died in four months' time. McGavic stresses the fact that biopsy is often confusing, as lymphoid tissue taken from differ ent parts of the body in the same patient presents different invasive stages and makes identical pictures impossible

Treatment *McGavic reports that eleven of* the seventeen primary lymphoid tumors of the adnexa did not recur after x ray therapy Martin feels that lymphomas and lympho-sar comas in the region of the head and neck should be treated as local single lesions such as pri mary tumors of the tonsils He recommends the same irradiation therapy that is used for retinoblastomas.

SARCOID

(1 Case) A generalized systemic disease it typically affects the eye and ocular adnexa, i.e the lids the conjunctiva, extra-ocular mus cles, and orbital tissues. Anterior uveitis, and less commonly choroiditis may also occur (Woods)

The lid lesions (Fig 411) are simultaneously associated with other lesions of the skin and there may be general glandular enlargement X rays may show mediastinal enlargement and cystic changes in the long bones of the hands

and feet Anergy to tuberculin is present in fifty per cent of the cases.

These lid tumors consist of sharply circumscribed nodules deeply situated in the skin which elevate the epidermis The nodules do not break down often they disappear promptly although some may last for years

TABLE 30

DIFFERENTIAL DIAGNOSIS, COMMON PRIMARY MALIGNANT LID TUMORS

	AGE	RATE OF GROWTH	LOCATION	APPEARANCE	DEGREE OF MALIGNANCY	TREATMENT
Carcinoma basal cell	Adult 20–80 most frequent 40–60	Slow	Most common lower lid or at inner canthus 2–6 mm. away from lid margin	Hard overlying skin scaly with telangiectasis when breaks down hard edge under cut bleeding points—base	Local extension metastases rare. Lymph nodes rarely involved	Surgery and irradiation (see text)
Carcinoma squamous cell	Adults 20–80	Moderately rapid	Typically at mucocutaneous junction	Hard-elevated edge, ulcerated base. Weep serous fluid Removal of crust leaves bleeding points.	Metastases early and distantly to lymph glands	Surgery and irradiation
Papillary carcinoma	Adults 20–80	Slow	Diffusely involving lids	Keratotic roughened grey thickening of skin resembling rubbery elephant hide	Superficial low malignancy does not usually metastasize	Surgery and irradiation
Sarcoma	Any age	Slow or rapid	May be associated with orbital lesion	Hard—may or may not be pigmented rapid growth Biopsy only sure diagnosis	Usually locally invasive and of variable degrees of malignancy and metastatic characteristics.	Surgery and irradiation
Lymphoma	Usually adults	Usually rapid	Mass in upper or lower lid may be bilateral	Masses almond shaped, moderately firm	Associated usually with generalized glandular involvement.	Irradiation

Pathology Hard tubercles without caseation made up of epithelioid cells with an occasional giant cell and a ring of leucocytes are the typical picture Giant cells sometimes contain doubly refractile bodies (Shaumann bodies)

Treatment. No specific therapy is known at present. Ultra violet light treatment of the whole body may possibly be beneficial.

TUMORS OF THE CONJUNCTIVA AND CORNEA

Tumors of the conjunctiva and cornea will be discussed together as a great many of them arise at or close to the limbus and involve both As in tumors of the lids benign dermoids, nevi and angiomas are found occurring in childhood with no malignant tumors in this series On the other hand, in adult life malignant tumors are as common as the benign In deciding

therapy this important point cannot be over emphasized Of the eighty two tumors observed in both age groups sixty nine were benign and thirteen were malignant Twenty five of these were dermoid or teratoid type tumors twenty-one were nevi two angiomas twelve, papillomas two fibromas two, xanthomas two epithelial hyperplasia one con junctival cyst one lymphoma nine carcinomas, and four melano-sarcomas.

Benign Tumors of Conjunctiva and Cornea

TERATOMAS TERATOID TUMORS AND DERMOIDS

These congenital tumors are frequently associated with other congenital defects of the eyes, adnexa and other parts of the body Usually noted in the first few years, they may enlarge

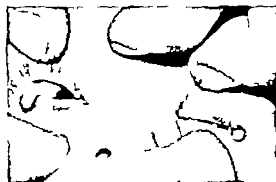


Fig. 412 Bilateral teratoid tumors of conjunctiva

slowly or stay relatively stationary Removal is desirable for cosmetic or functional purposes.

TERATOMAS

(0 Cases) Containing all germ layer products, these are rare tumors showing a predominance of bone (Epibulbar osteomata, Ref Ballantyne) with a true Haversian system around endothelial-lined blood spaces Usually located in the bulbar conjunctiva of the upper temporal quadrant these teratomas may take on the growth formation and the potential malignancy of teratomas elsewhere in the body

TERATOID TUMORS

(7 Cases) These benign tumors in the conjunctiva are common. They contain the products of some of the germ layers, but not all. Like the osteomata they are commonly seen in the upper temporal quadrants of the bulbar conjunctiva or they may be multiple around the limbus (Rosen) Usually well-circumscribed oval or almond-shaped solid or cystic, these tumors are movable over the sclera

One eighteen-month old boy had bilateral teratoids that moved easily on the sclera At the apex of each of these tumors was a teat like formation, protruding 5 millimeters between the lids at the outer canthus and showing some erosion at its distal end (Fig 412) The tumors at operation were found to join with the orbital fat but were not attached to the globe They consisted of stratified epithelium muscle, nerve and glandular structures with duct formation Carter reports a case of a unilateral tumor that grossly appeared very similar but was attached to the sclera and to the choroid as well.

DERMOIDS

(18 Cases) These are very common epibulbar tumors and include the products of both the epidermis and the dermis. The usual site of the dermoid is straddling the limbus at the lower outer quadrants, but they may be found anywhere in the conjunctiva (Fig 413 A B) The tumor is three to six millimeters in diameter opaque and pinkish white in color Firmly fixed at the limbus it involves about one-half of the anterior corneal stroma but overlies the sclera A few hairs, which may become more profuse at puberty are often seen protruding from the surface Their presence is diagnostic. Occasionally limbal dermoids are associated with a notch in the upper lid One case in our series had bilateral limbal growths and a notching of the left upper lid (Fig 413 C)

DERMOLIPOMATOMA AND FIBROLIPOMATA

(2 Cases) These are thought by many to be variations of dermoids and have either a predominance of fatty or fibrous type tissue

Differential Diagnosis

(1) Cavernous angiomas often have a bluish

color, are compressible, and may show dilated vessels entering the tumor

(2) Lymphomas are often bilateral, may be associated with general glandular enlargement and with blood picture changes.

(3) Orbital tumors, the sarcomas and lymphomas with anterior extension must always be considered.

(4) Epidermoid carcinomas occur in the older age groups and do not have hairs on the surface.

Pathology (A) Teratomas contain products of all the germ layers and are most frequently seen with bone formation (B) Teratoid tumors may contain products of any germ layer, but not of all three layers together (C) Dermoids may show stratified epithelium, fibrous tissue nerve tissue hair follicles and sebaceous glands

Treatment Dermoids and teratoid tumors, including dermolipomas and fibrolipomas of the bulbar conjunctiva that are located away from the limbus, are in children removed under general anesthesia in adults under local anesthesia. A Parke speculum gives the best lid retraction for bulbar and intraocular work.

Technique With the speculum in place the globe is rotated with fixation forceps to give the best exposure of the tumor The subconjunctival tissue is infiltrated with 2 per cent novocaine to elevate the tumor and this also demarcates the edges more distinctly The tumor is picked up with forceps and excised close to its margin The conjunctival edges are then approximated with a five-zero plain cat gut and an atraumatic needle using small interrupted stitches. Owing to the elasticity of the conjunctiva, there is rarely any difficulty in closure

The Limbal Dermoids are firmly fastened to the cornea and penetrate the superficial stroma It is thus important to use a sharp corneal dissector and begin the dissection on the corneal side of the tumor, doing actually a small lamellar keratectomy By these means, the whole tumor can be removed Care should be taken not to perforate the cornea in the dissection as some dermoids are deep The conjunctival portion of the dermoid is easily removed The conjunctiva is closed at the limbus over the conjunctival defect which is permitted to epithelialize This process requires about forty eight to seventy two hours If vessels begin to invade the cornea in the denuded area, three gram-seconds of contact beta irradiation at the limbus will adequately control the invasion



Fig 413
A Large dermoid at the limbus showing hairs on surface.
B Small dermoid at limbus.
C. Limbal dermoids have been removed—associated notching of upper lid.

NEVI

(21 Cases) Common, benign, congenital tumors of the conjunctiva nevi may be single or multiple Usually located in the scleral triangles at or near the limbus or the caruncle, one is rarely seen in the fornix (Fig 414 A and B) This tumor, which is elevated with a slightly roughened surface may have varying degrees of pigmentation In some small cystic areas may be present When avascular and well-circumscribed dark brown or black spots are noted from birth the nevus is not difficult to diagnose. The less-decisively pigmented tumors, with a feathering of the pigment along

the vessels, may be extremely difficult to evaluate, for pigment content according to Reese may change from premelanin to melanin at puberty or during pregnancy. Reese in reviewing the literature found only two cases of malignancy developing from pre-existing conjunctival nevi. Nevi at the caruncle present very much the same appearance as nevi at the limbus though in this area hairs of the caruncle frequently grow through the tumor mass. This is felt to be evidence of the benign nature of the tumor.

Differential Diagnosis. Nevi must be differentiated from

(1) *Malignant Melanosis* which occurring in the fifth or sixth decade is a diffuse granular deposit of yellowish pigment in the conjunctiva where previously no pigment was found (Pg. 527)

(2) *Malignant Melanoma* which is found in the older age group. Located in the scleral triangles it may be flat, vascular and show feathering of pigment along the vessels (Pg. 528)

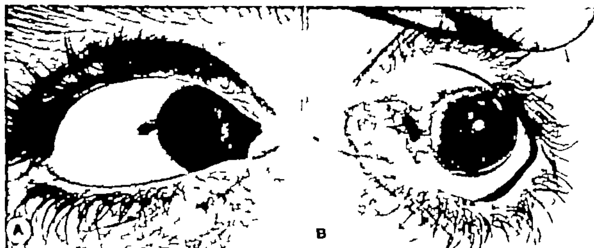


Fig. 414

A. Nevus at limbus—pigment well circumscribed.
B. Nevus at limbus—pigment diffuse.

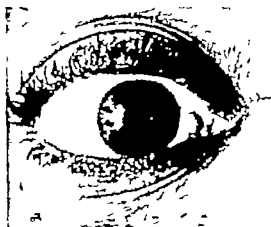


Fig. 415 Pinguecula

(3) *Pinguecula* seen in adults, are yellowish flat benign masses which lie in scleral triangles near the limbus and are composed of hyalin material and yellow elastic fibrous tissue (Fig. 415)

Pathology. The nevus is generally considered to be of neuro-ectodermal origin. It consists essentially of groups of large flat polygonal nevus cells, which may or may not contain pigment. The surface epithelium is intact but it dips between the clumps of cells and may frequently contain some pigment in the basal layers.

Treatment. No therapy is necessary unless the nevus changes in size or is cosmetically disturbing to the patient. These tumors are insensitive to irradiation and must be removed surgically. Infiltration of the subconjunctival area with 2 per cent procaine elevates the nevus and greatly facilitates the excision which should be made with a three millimeter margin.

The elasticity of the conjunctiva facilitates closure (Fig 416 A and B)

ANGIOMAS

(2 Cases) Hemangiomas and lymphangiomas of the conjunctiva consist of endothelial lined spaces filled with blood or lymph (Fig 417–418) *They are relatively common congeni*tal benign tumors found in the bulbar or palpebral conjunctiva. These hemangiomas are frequently associated with hemangioma of the lids, the orbits or the intraocular structures They vary in type from those with a few dilated capillaries to others with well incapsulated masses. Capillary hemangiomas usually present a bright red appearance of small tortuous capillaries *These are discrete in the con*junctiva and are easily movable on the underlying sclera

Cavernous-type hemangiomas are purplish in color, firm yet compressible and often lobulated. They are frequently associated with orbital extensions, when nasally placed the caruncle is involved. Only two cases of the *cavernous type were found in our series of* eighty three conjunctival tumors but this does *not give a true picture of their frequency* since many were irradiated without biopsy (Fig 419 A and B)

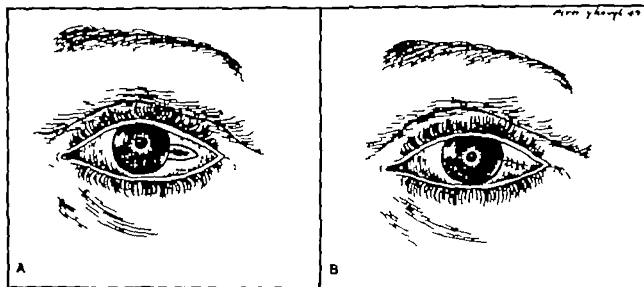


Fig. 416. Removal of nevus



Fig. 417 Hemangioma, capillary



Fig. 418 Lymphangioma conjunctiva

Pathology Capillary hemangiomas consist of dilated capillaries with very little supporting stroma Cavernous hemangiomas, on the other hand consist of dilated endothelial lined spaces with varying amounts of supporting

tissue In some the supporting fibrous tissue is so marked that the tumors may be classified as fibro-hemangiomas.

Treatment. Using local topical pontocaine or cocaine anesthesia capillary hemangiomas can be occluded by actual cautery or by beta cauterized before the removal When the tumor is less encapsulated and more diffuse, it is best to use irradiation This can be done readily as described under beta irradiation therapy for lid tumors. It is important to stress to the patient that with these tumors mild doses of



Fig. 419

A. Angioma of caruncle and lid
B. Angioma of caruncle—2 years after Beta irradiation therapy



Fig. 420 Conjunctival papilloma

irradiation over a longer period give more satisfactory results than do shorter courses of intensive therapy

PAPILLOMAS

(12 Cases) These are common benign epithelial tumors of the older age group Eleven of this series were in people over forty one in a boy of thirteen Papillomas around the caruncle do occasionally appear in children

Conjunctival papillomas occur in the upper fornix, at the lid margins, near the puncta or caruncle They may be single or multiple and occasionally are bilateral The appearance is extremely variable depending on the location. In the cul-de sacs the tumors may be pink (Fig 420) friable pedunculated masses with fingery extensions which may be separated by

irradiation therapy given for five gram seconds contact and repeated at four weeks intervals, if necessary

If the cavernous hemangiomas are well-circumscribed they can be removed surgically with the afferent and efferent vessels tied or

a probe At the lid margins they are usually more compact and mulberry-like and they may break down causing the formation of crusts and bleeding points

Limbal papillomas have an entirely different gross appearance from the pedunculated friable tumors of the cul-de-sacs However under the high power slit lamp the same distinctive papillomatous formation can be seen Grossly they are elevated tumors with a flat irregular surface The origin is at the limbus, but the extension may be out over the cornea or back over the conjunctiva as far as the cul-de sac. One patient had tumors appear almost simultaneously in both eyes at the lower outer quadrant of the limbus (Fig 421 A and B)

Differential Diagnosis. *Conjunctival papillomas* usually have friable fingery extensions which differentiate them from

(1) Chronic granulation tissue which occurs after chalazia have ruptured and repeatedly filled and drained

(2) Polypoid fibromas which are smooth and friable and produce bloody tears

Limbal papillomas must be differentiated from

(1) Epitheliomas which occur in the same age group but are usually smoother and frequently have small yellowish deposits on the superficial layers.

(2) Limbal dermoids which have hairs projecting from their substance and have been present since birth

(3) Senile hyperkeratoses or plaques are whitish elevations at the limbus which may be difficult to distinguish from an early papilloma or epithelioma Their growth is much slower and the plaque causes more lid irritation

(4) Early pterygia are located usually nasally at the limbus, the vessels running directly toward the head The vessels supplying a papilloma course over and through the conjunctiva without definite pattern (Fig 422)

Pathology Conjunctival and limbal papillomas present the same pathological appearance There is a central core of fibrous tissue which is vascular and this is covered by stratified squamous epithelium. The epithelium may be greatly thickened and the papillomatous processes are closely packed together There



Fig 421
A. Limbal papilloma extending to caruncle and upper fornix.
B Limbal papilloma after irradiation therapy



Fig. 422 Pterygium

may be considerable variation of the component parts, the tumor being so fibrous that it may be mistaken for a pterygium. When the tumor extends over the cornea Bowman's

membrane may be destroyed but the substantia propria is not infiltrated or involved nor is the basement membrane of the conjunctiva penetrated or disturbed.

Treatment. Pedunculated papillomas of the palpebral conjunctiva are expeditiously removed by surgery. In most cases a topical application of 4 per cent cocaine or ½ per cent pontacaine is sufficient anesthesia. It is well to touch the base of the tumor with a hand cautery to occlude the central vessel and make recurrence less likely. If the patient does not wish surgery, these friable papillomas respond dramatically to small doses (3–5 gram seconds) of beta irradiation. The results, although not as rapid as surgery, are permanent.

Limbal papilloma can be equally well treated with beta irradiation. When the tumor is removed, the eye usually returns to normal without any functional or cosmetic disturbance. The return of 20/20 or 20/30 vision is not uncommon in cases in which the tumor has covered the center of the cornea. A woman of sixty four years with a typical limbal papilloma of three months duration, was treated first in May 1943. Contact beta irradiation totaling 57 gram-seconds in four treatments was given over a period of six weeks. In ten weeks the lesion had completely cleared leaving vision of 20/20. The patient has been followed five years to date without recurrence. A combination of surgical and irradiation therapy in limbal papilloma produces rapid results.

FIBROMAS OF CONJUNCTIVA

(2 Cases) Fibromas of the conjunctiva are usually seen in the palpebral surface of the lids and consist of polypoid masses, smooth in contour and extremely friable. Commonly these are vascular and bleed easily. On occasion they are seen at the caruncle on the upper fornix or limbus (Mano).

Differential Diagnosis. Fibromas must be differentiated from

(1) Chronic granulation tissue
(2) Papilloma of conjunctiva

Pathology. The tumors consist of masses of fibrous tissue and a great number of young connective tissue cells, infiltrated with lymphocytes and leukocytes. There is a stratified squamous epithelial covering. This is differentiated from that of the papilloma where there is a straight or branching central core of connective tissue with vessels covered by epithelium.

FIBROMAS OF CORNEA

(0 Cases) These fibromas were described by Smith, who reviewed thirty-seven cases in the literature. Believing that many so-called fibromas of the cornea are really keloids, he gives supporting evidence to substantiate this point. The existence of primary fibrous tumors of the cornea had not been satisfactorily established, either clinically or pathologically.

Pathology. Most of the tumors are anterior staphylomas of the cornea with fibrous hyperplasia.

XANTHOMAS

(2 Cases) The xanthoma of the conjunctiva may be a localized lesion as a part of a general disease involving the skin. Two cases of our series presented elevated yellowish lobulated masses in the conjunctiva. The tumors are most frequently seen in the scleral triangles and may be associated with typical xanthomatous skin lesions.

Pathology. Similar to xanthoma of the lids.

Treatment. Surgical excision.

EPITHELIAL HYPERPLASIA

(2 Cases) Tyloma or Epithelial Plaque is found in the older age group. It is situated in the scleral triangle nasally or temporally at the limbus. Chalky white in appearance these are freely movable on the underlying tissue. The size is variable usually one to two millimeters in diameter. Lid motion causes irritation.

Differential Diagnosis. Epithelial hyperplasia must be differentiated from

(1) Papillomas
(2) Pterygiums & pseudopterygiums (Fig 422)
(3) Malignant epitheliomas

(4) Bowen's disease already discussed under papillomas

Pathology The tumor consists of a mass of thickened and keratinized epithelium without connective tissue core There may be dipping of the papillary processes in the sub-epithelial layer and a marked superficial palisading of the cornified epithelial cells.

Treatment. Excision.

CONJUNCTIVAL CYSTS

(1 Case) Implantations or inversions of the epithelium these cysts occur most often in the lower cul-de sacs (Fig 423) Some are small, others attain large dimensions. Transillumination shows small chalky deposits on the surface of the cyst Occasionally small cysts may be found around the limbus as a result of an old limbal keratitis (Fig 424)

Differential Diagnosis. Conjunctival cysts must be differentiated from

(1) Cystic dermoid which is usually situated deeper in the tissues.

Limbal cysts must be differentiated from

(1) Early limbal vernal conjunctivitis which associated with symptoms of itching and stringy mucous discharge (Fig 425)

(2) Small cystic nevi which are located at limbus and usually contain pigment.

Treatment. If the cysts are causing functional difficulties they should be excised

RHINOSPORIDIUM SEEBERI

(0 Cases) A rare tumor of the conjunctiva this was first reported in America by Anderson and Byrnes in 1939 An inflammatory reaction to Sporangia Seeberi it is usually found in young males and consists of a painless pedunculated growth of the bulbar conjunctiva of the fornix Pink in color and irregularly lobulated the tumors may protrude between the lids Over the surface are cream colored granules containing the sporangia. These can be expressed on a slide

Differential Diagnosis. Differentiate from granulation tissue which may follow injury or operation

Pathology The epithelial covering of connective tissue stroma is infiltrated by chronic inflammatory cells and particularly by the plasma cell in which cysts and sporangia are found

Treatment. Surgical excision

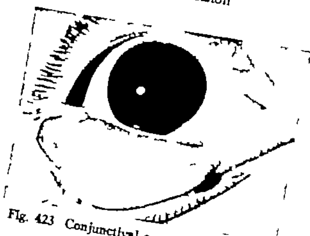


Fig. 423 Conjunctival cyst, lower cul-de-sac



Fig 424 Cysts at limbus

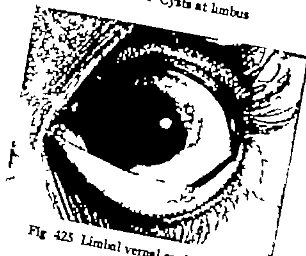


Fig 425 Limbal vernal conjunctivitis

PLASMOCYTOMAS

(1 Case) These are rare tumors of the conjunctiva which are chiefly composed of plasma cells. The one case seen clinically in this series

TABLE 31

Differential Diagnosis, Common Benign Conjunctival Limbal Tumors

	Time of occurrence	Location	Fixation	Clinical appearance	Must be differentiated	Benign or malignant	Treatment
Teratoid tumors of conjunctiva and dermolipoma fibrolipoma	Relatively common congenital	Upper temporal quadrant bulbar conjunctiva	Moveable over sclera	Conjunctiva thickened may be dull white or pink often almond-shaped	1 Hemangioma 2. Lymphoma 3 Lymphangioma	Benign	Surgical excision
Dermoid limbus	Congenital	Most frequently at limbus lower temporal quadrant conjunctiva, may be associated with notching of lid	Fixed to cornea slightly moveable on sclera	Hairs from surface which is dull, white or yellowish	1 Epitheliomas 2. Hyperkeratosis	Benign usually self limited growth	Surgical excision
Nevus	Congenital	Conjunctiva Scleral triangles at or near limbus or at caruncle	Freely moveable over sclera	Slightly elevated with roughened surface, all degrees of pigmentation	1 Malignant melanoma 2 Malignant melanosis early 3 Pinguecula	Benign	Surgical excision
Angioma	Congenital	Anywhere in conjunctiva	Moveable over sclera but may be associated with orbital extension	Capillary hemangioma bright red cavernous hemangioma darker red and bluish in color	1 Dermoids or teratoid tumors 2. Neurofibroma lymphoma	Benign usually self limited in growth	Irradiation
Conjunctival papilloma	Adult life occasionally in children around caruncle	Anywhere in conjunctiva more frequently cul-de-sac, lid margin or around caruncle or puncta	Moveable on sclera or underlying structures	Friable pink tumor with fingering extensions	1 Fibroma of conjunctiva 2 Adenoma of caruncle 3 Granulation tissue	Benign	Surgery or beta irradiation

TABLE 31—CONTINUED

	TIME OF OCCURRENCE	LOCATION	FIXATION	CLINICAL APPEARANCE	MUST BE DIFFERENTIATED	BENIGN OR MALIGNANT	TREATMENT
Limbal papilloma	Adult life	At limbus but may extend into fornix or over cornea	Relatively fixed at limbus	Elevated flat rough surface pinkish grey tumors under slit lamp show papillomatous formation	1 Epithelioma of limbus 2. Bowen's intra-epithelial epithelioma 3 Limbal dermoid 4 Senile hyperkeratosis	Benign	Irradiation or surgery
Fibroma of conjunctiva	Adult life	On palpebral surface or in fornix	May be fixed at base usually freely moveable.	Polypoid smooth pink friable produce bloody tears	1 Papilloma 2. Chronic granulation tissue of chalazion	Benign	Excision
Epithelial hyperplasia	Adult life	Usually limbal	Moveable	Greyish chalky opaque avascular	1 Epithelioma 2. Papilloma	Benign	Excision
Xanthoma	Adults	Scleral triangles Conjunctiva	Moveable on sclera	Yellowish lobulated	1 Dermoids	Benign	Excision

involved all the orbital structures in addition to the conjunctiva and is discussed under Tumors of the orbit

TUBEROUS SCLEROSIS

(0 Cases) Tuberous sclerosis of the conjunctiva was reported by Luo in a patient who had a typical Bourneville syndrome and, in addition a lesion of the left retina The lesion consisted of symmetrically-placed, reddish pedunculated nodules near the inner canthus at the lid margins

Pathology The nodules showed a hyperplasia of collagenous fibrous tissue

NEUROFIBROMAS

(0 Cases) Neurofibromas of the conjunctiva occur in patients having generalized neurofibromatosis Kolie and Brailey reported such tumors to be yellowish grey two millimeters in diameter and situated at lid margins

SARCOID

(0 Cases) Sarcoid nodules of the conjunctiva are rare and are always associated with manifestations of the disease elsewhere in the body (See Sarcoid of the Lids Pg 514) (Bledvail Folk.)

ADENOMATA

(0 Cases) These are rare benign tumors of the conjunctiva that involve the glands of Krause in the upper cul-de-sacs, and in this area are usually cystic. When the glands of the caruncle become involved as often happens the tumors are pink friable and clinically undifferentiated from papillomas.

Treatment. Surgical excision and beta irradiation

Malignant Tumors of the Conjunctiva and Cornea

Epitheliomas

(9 Cases) Epitheliomas or epidermoid carcinomas are most frequently seen at the limbus, but they do occur at the caruncle and in the bulbar and palpebral conjunctiva. Trauma as a possible etiology may be of some importance. As in carcinoma of the lids, epitheliomas are more common in the fifth, sixth, and seventh decades however they may sometimes be found in younger age groups (Fig 426 A) They are almost always of the squamous cell type (Fig 426 B) but in this series of nine cases one basal-cell tumor was found. pain or it may extend into the fornix, causing relatively few symptoms In the advanced stages intraocular or orbital extension takes place, but metastases occur late Of the nine cases of carcinomas in this series, four were treated by simple surgical removal followed by irradiation, and five treated by surgery alone One recurrence was in a case where the tumor was surgically removed without the additional irradiation and here an exenteration of the orbit became necessary

Among the forty-eight cases of limbal carcinomas reported by Ash and Wilder only one death occurred that could possibly be attributed to the tumor Simple excision eradicated the lesion in twenty three cases but in two,

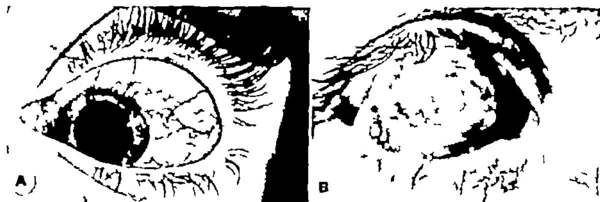


Fig 426

A. Epithelioma of conjunctiva early
B Epithelioma of conjunctiva advanced

additional surgery was required Enucleation was performed in the remaining twenty three. It is possible that this high percentage of cases enucleated might have been fewer had the diagnosis been made earlier and surgery plus irradiation promptly instituted

Limbal epitheliomas begin as small, greyish white opaque nodules that can be easily confused with senile hyperkeratoses. The growth is often quite slow and may change little for years, but when it does may enlarge rapidly Dilated afferent and efferent vessels course through the conjunctiva The tumors are pinkish grey in color with a scattering of small reddish yellow spots over the surface Under the slit lamp the general contour is smoothly lobular with the small vessels forming a characteristic bud at the apex of each lobule Areas of superficial erosion are not unusual In most cases the tumor mass is fixed to the cornea but *it does not invade the stroma until very late* The spread may be either confined to the cornea producing a keratitis with considerable

Differential Diagnosis.

(1) Benign papillomas which have a rougher surface rarely break down or cause a keratitis, and lack the small reddish spots seen on epithelioma they can only be definitely differentiated from epitheliomas by biopsy (Pg 520)

(2) Bowen s Disease Biopsy diagnosis.

(3) Senile Hyperkeratosis is more of a chalky white in color and less vascular

Pathology The typical epithelial pearls or cell nests, are surrounded by prickle and polyg-

onal cells and these, in turn by cuboidal and cylindrical cells The nuclei are of varied size and form. There is usually present a considerable inflammatory reaction. Ash and Wilder reported forty-eight tumors at the limbus of these thirty nine were the squamous cell epidermoid type of carcinomas, eight were papillary carcinomas, and one was a basal-cell type

Treatment. Epitheliomas of the limbus are of low grade malignancy as compared to tumors of this kind elsewhere, and thus can be treated with relative conservatism. For small tumors beta irradiation has given spectacular results with no functional or cosmetic defect. The dosage depends on careful observation of the reaction of the lesion to each treatment.

In very large epitheliomas, especially when the fornix is involved the use of beta irradiation in conjunction with careful surgical excision is advised, for together they give the best functional result, without scarring and distortion The follow up should be systematic and any small recurrence immediately irradiated

INTRAEPITHELIAL EPITHELIOMA (BOWEN S DISEASE)

(0 Cases) McGavic reported this disease as a syndrome involving both cornea and conjunctiva at the limbus The lesion is slightly elevated diffuse and sometimes multiple with highly vascularized patches of reddish-grey gelatinous tissue

Differential Diagnosis. Clinically the tumor is confused with the papillomas and epitheliomas microscopic examination being the real differentiating point

Pathology The tumor mass is made up of epithelial cells showing great variation in size shape and staining characteristics. Mitoses are numerous, and there may be many giant cells, known as "monster cells The basement membrane is characteristically not invaded but lying beneath this particular membrane is an inflammatory layer of plasma cells and leukocytes.

Treatment. Complete surgical excision is the procedure of choice Beta irradiation though not tried to date on Bowen s disease should give results comparable to those obtained from treatment of epithelioma.

PIGMENTED TUMORS

(0 Cases) Pigmented tumors are mistakenly grouped together clinically at times. Actually the pigment content of the cell is not characteristic of the type cell, nor indicative of the degree of malignancy Confusion occurs, because we find three types of tumor cells in the same area all of which contain pigment

1 The benign neuroectodermal, congenital nevus.
2 The malignant, cancerous melanosis of epithelial origin
3 The malignant melanoma, or melanosarcoma, of mesodermal origin.

MALIGNANT CANCEROUS MELANOSIS

(0 Cases) Melanosis of the conjunctiva comes typically according to Reese, in the fifth and sixth decades, where previously no pigmentation showed. There is rather wide involvement, and when viewed with the high power slit lamp the conjunctiva presents a granular non-elevated, pigmented appearance in which the pigment is yellowish rather than brown or black. Seventeen cases were reported in Reese s series, five of which were considered in the precancerous stage He found that there is usually a period of five to ten years between the precancerous and malignant stage The precancerous cases were irradiated and excellent results were obtained Twelve of the patients when first seen were in the malignant stage Seven of them died one presumably is dead and four are still living Of the four living three were exenterated one refused this therapy Of the three exenterated one has been followed nine years, the other two have been recently operated Reese felt that temporizing procedures in these cases might lead to fatal consequences In none did there seem to be any contraindication to biopsy

Differential Diagnosis. Malignant melanosis must be differentiated from

(1) Veri which are circumscribed congenital tumors of brown or black pigmentation

(2) *Melanomas* which are more circumscribed and more vascular and in which capillaries are tufted and supply definite clumps of pigment.

(3) *Melanosis Oculi* an increased pigmentation of all the pigment bearing tissues of the eye and of the uveal tract as well.

Pathology According to Reese, the basal cells of the conjunctiva increase in number become pigmented swollen and hydropic. In some instances the basal layer proliferates and, in others it is segregated into clumps. Individual cells may vary in amount of pigment The change from the precancerous melanosis to the malignant stage is very definite The cells begin to show invasive tendencies, mitotic figures are numerous, and a marked inflammatory reaction occurs.

Treatment. Reese has treated these tumors in the precancerous state with beta irradiation 32 gram seconds per area with excellent results. In the malignant state he feels that exenteration is indicated just as soon as the diagnosis has been confirmed by biopsy

SARCOMAS

(4 Cases) Sarcomas have a confusing terminology and have been classified as malignant melanomas melanosarcomas and leucosarcomas

Melanosarcomas are tumors which clinically contain pigment leucosarcomas clinically do not contain pigment Actually pigment is present in both of them pathologically and the term malignant melanoma is the better one

MALIGNANT MELANOMAS

Malignant melanomas of the conjunctiva are most commonly found in the fifth sixth and seventh decades although they may occur earlier The earliest case in this series was at forty-eight years There is no sex specificity The tumors may involve any portion of the bulbar or palpebral conjunctiva When they occur in the fornix they are rather oval or spherical in shape with a smooth surface At the caruncle the shape is again smooth and polypoid In the scleral triangle near the limbus however the tumor is flat with roughened surface and feathered edge Vascularity is more prominent than in the nevus and the capillaries may be tortuous and tufted as they supply clumps or pigmented areas. The surface under the high-power slit lamp has a dusky appearance and the pigment is more frequently dark brown or black than yellow

Growth may be slow or the mass may even lie dormant for months. Then again growth may be rapid and fungating with necrosis as the blood supply is outstripped Extension into the orbital tissues, or to the globe along the perforating vessels, or an appearance of metastases in the proximal glands, liver or lungs is the course Metastases may be extremely slow in developing death ten to fifteen years after removal of the original tumor is not uncommon One early case in the Wilmer records not included in this ten-year series, died eight years after an exenteration for orbital extension of a choroidal melanoma. During this time the patient bore three children and led a vigorous normal life

Melanin is not usually found in the urine but when present is diagnostic of a melanoma If it should be present before operation and absent after operation this change is presumptive evidence of complete eradication of the tumor If on the other hand melanin continues to be present in the urine or after brief absence reappears, then local recurrence or metastasis has taken place

A brief review of the four cases in this series may be instructive

Case 1—A fifty year-old white male stated that his father and two sisters had died of carcinomas and that one brother had cancer of the stomach In 1943 the patient was seen with an epithelioma of the bulbar conjunctiva, so typical that it was not biopsied. After 40 gram seconds of Beta irradiation it disappeared completely In January 1946 three years after the initial lesion the patient developed a small skin nodule on the upper lip which was biopsied and found to be an epithelioma This was treated with x ray and to date there has been no recurrence in that location In December 1947 the patient returned for his six months check and reported the presence of a black nodule of two months duration in the fornix beneath the upper lid (Fig 427) The nodule was well circum

scribed and lay in the conjunctiva of the upper fornix, distant from the site of the lesion of the original epithelioma of the bulbar conjunctiva. The mass, of pea size and gray-black color was well demarcated and movable on underlying structures. The tumor together with a wide margin of conjunctiva, was surgically removed and the base and surrounding conjunctiva irradiated on the theory that the tumor might be of the pigmented epithelial type described by Reese, rather than of sarcomatous origin. Pathological section showed a *mixed cell melanoma* and Doctors Friedenwald Reese, and Ash all agreed that the malignancy as evidenced by the sections, called for an exenteration of the orbit. This was immediately done. Section taken around the site of the tumor showed no tumor cells, but a moderate post-irradiation reaction. The patient has been followed one year and a half to date with no recurrence

Case 2 was that of a fifty-six year-old white man who in 1936 had a dark mass removed by his local doctor from the upper fornix of the left eye. This gradually recurred and when seen in 1939 was a dark nodular mass 4 x 6 x 2 millimeters in the conjunctiva of the upper fornix (Fig 428) It was freely movable on the subconjunctival tissue, and over the sclera. Clinically the diagnosis was malignant melanoma pathologically spindle cell type A. Exenteration, though advised was refused. The mass was removed with as much conjunctiva as possible. The patient has been followed ten years to date and is living without recurrence.

Case 3 that of a forty-eight year-old white man in 1944 showed a small pigmented spot near the limbus which had been noted about one year earlier and had increased in size and vascularity in the last several months. The pigment was brown not well-circumscribed and had a feather edge extending out along the vessels. The mass was about 1½ mm. in diameter was slightly elevated and fixed at the limbal margin and not over the sclera. Clinically the tumor was felt to be a malignant melanoma, and the eye was enucleated The pathological diagnosis was mixed cell type. On the follow-up one year later the patient noted a small nodule in the depths of the orbit. Clinically this was thought to be a recurrence and exenteration was done No tumor however was found in the specimen. The patient has been followed for three years to date without recurrence

Case 4 was a fifty-six year-old white woman with a history of a mass protruding from the right eye for two years time. The tumor had been locally excised by her family doctor but had promptly recurred. When seen in the clinic all the orbital structures were fixed and there was questionable enlargement of the liver Biopsy of the fungating mass showed a necrotic melanoma. Prognosis was felt to be zero Death from generalized metastases was reported within one year

In summary Of the four conjunctival melanomas, two were in the upper cul-de sac one in the scleral triangle and one was so extensive when first seen that its origin could not be determined

Two were mixed tumors and these were exenterated There has been no recurrence for



Fig 427 Melanoma of conjunctiva



Fig. 428. Melanoma of conjunctiva of fornix and upper lid.

one and one half years and for three years respectively One was a spindle cell type A and, locally excised has had no recurrence in ten years One was a necrotic tumor and the patient is dead

Differential diagnosis Malignant melanoma must be differentiated from

(1) Nevi
(2) Malignant cancerous melanosis

Pathology As described under choroid for malignant melanoma.

Treatment of Conjunctival Melanomas. X ray therapy is valueless. Surgical excision more radical than otherwise is indicated as the primary procedure A wide margin of the conjunctiva should be removed with the tumor If on pathological study the tumor proves to be a *spindle cell A* or *B with a high* reticulin count it is justifiable to do no further surgery but to watch the patient carefully If the tumor proves to be a mixed-cell type an epithelioid or a necrotic type exenteration of the orbit should be done immediately

Exenteration Technique Exenteration of the orbit for malignant melanoma includes removing the lids. General anesthesia is necessary An incision made through the skin, subcutaneous tissue muscle and fascia down to the orbital rim is *extended* until *the orbital contents have* been circumscribed Then the periosteum is cut and elevation using a periosteal elevator is begun temporally The periosteum strips easily as far as the trochlea, which can best be removed with a knife or sharp dissector Special care is taken in elevating the periosteum of the nasal wall as the lamina is extremely thin and a break into the ethmoids will delay healing *as mucous membrane proliferates through the* break. When the periosteum has been stripped to the apex of the orbit the vessels, nerves and fascia are cut by the electro-cautery as close to the foramen as possible This method helps to control bleeding The orbit is packed with a hot saline sponge while a Thiersch graft roughly 10 x 10 cm. and as thin as possible *is cut from the inner portion of the* thigh either free hand or with a dermatome A few holes in the graft are no disadvantage since several small stab wounds are required for drainage.

It is important that all orbits should be grafted immediately and the Thiersch grafting on the bone is much to be preferred to tube or flap grafts Waiting for the orbit to —nulate *before pinch grafting is not only* d on the patient, but is outmoded

Only when the orbit is *absolutely dry and all bleeding controlled* should the Thiersch graft be sutured with very fine silk to the cut edge of the skin at the orbital rim. This, although a time-consuming chore is most important for rapid healing The graft is then gently pushed into the dry orbit and held in place by a sea sponge covered with one thickness of vasoline gauze. It is extremely important that the skin flap does not roll up at the edges and that the under surface is in contact everywhere with the bare bone

The orbit should not be dressed for at least a week release of pressure of the dressing disturbs the new capillaries entering the graft permitting blood clots to form and dislodge parts or all of the graft. Penicillin given parentally prevents secondary infection and perhaps gives a higher percentage of takes in most instances however poor takes are not the *result of infection but of poor bone to-skin* apposition caused by bleeding in the orbit

LYMPHOMAS

(1 Case) These are considered either as malignant or potentially malignant tumors related to the vast group of lymphoid diseases such as the leukemias, Hodgkin s disease and chloromas. Primary lymphomas of the conjunctiva *are rare These tumors have no sex* specificity and while they occur in any age group Shulz and Heath found them more common in adults.

The prognosis of lymphoma of the conjunctiva when found as a primary and separate lesion is much better than that of conjunctival involvement associated with generalized disease *In the latter the rate cured* varies from 10.5 to 14 8 per cent in a five year period.

The case in this series was a woman of twenty five who had noticed a peculiar growth in both lower cul-de sacs for about two months time (Fig 429 A and B) The picture was that of a follicular hyperplasia and, on biopsy showed a small round-cell infiltration *without any evidence of malignant change* She was treated with beta irradiation (60 gram seconds) contact therapy spread along the in-

ferior cul-de-sac of each eye and has had no recurrence in two years This patient interestingly enough, had a hemangioma on the back of the hand and a spina bifida

McGavic reported five cases of subconjunctival primary lesions all of which were followed for two years or longer, without recurrence after therapy The subconjunctival lymphomas in his series have the same clinical appearance and course and are of the same histological type as the lymphoid tumors elsewhere in the body (Fig 430)

Rados reports a reticulum cell sarcoma of the conjunctiva which is one of the most undifferentiated cell types of all in lymphoid tumors Clinically the patient showed large papillary masses resembling vernal conjunctivitis and, on biopsy the cells proved to be large with a nucleus twice the size of a normal lymphocyte In spite of intense irradiation the patient died in four months time with generalized metastases.

Avery and Warren report a conjunctival lesion in a case of generalized Hodgkin's disease where flat reddish masses in the conjunctiva responded excellently to x ray therapy The patient had been followed for eight years and was still in excellent health

Pathology Classification of the lymphoid tumors is extremely difficult and variance in the diagnosis is possible as cell type varies in different sections of the same tumor as well as in sections of tumors from different parts of the body Cell types, such as lymphocytes, reticulum cells, giant follicles and undifferentiated cells are used as simplified sub-classifications the more complex ones add little toward clarifying and coordinating the clinical and pathological picture

Treatment Nitrogen mustard and beta chlorethylamine administered intravenously give reportedly good results The most satisfactory results, however have been reported by McGavic using x ray therapy as described by Martin and Reese for retinoblastomas. Martin feels that lymphomas of the eye and adnexa should be treated like a primary tumor with heavy irradiation

ENDOTHELIOMAS

(0 Cases) These rare tumors of the conjunctiva arise from the endothelial lined blood



Fig 429

A Lymphoma, benign
B Lymphoma after Beta irradiation



Fig 430 Lympho-sarcoma, upper fornix

spaces, and are usually located at the limbus. Duke-Elder includes also under this heading the cylindro-endotheliomas and the perio-endotheliomas. These are extremely rare tumors and the diagnosis can be made only by biopsy

TABLE 32

DIFFERENTIAL DIAGNOSIS, COMMON MALIGNANT CONJUNCTIVAL AND LIMBAL TUMORS

	Time of Occurrence	Location	Fixation	Clinical Appearance	Must Be Differentiated From	Benign or Malignant	Treatment
Epithelioma	In adults usually 5-6-7 decade	Usually limbus, but may be away from limbus	Fixed at limbus	Elevated flat smooth surface, pinkish gray with reddish yellowish dots from capillaries. Vessels feeding tumor dilated	1 Bowen's disease 2. Papilloma 3 Epithelial hyperplasia Tyloma	Low grade malignancy	Beta irradiation and surgery
Cancerous melanosis of conjunctiva	5-6 decade	Diffuse conjunctival pigmentation where previously conjunctiva showed no pigmentation	In conjunctiva not fixed on sclera	Granular pigmented appearance of conjunctiva. Diffuse yellowish brown	1 Malignant melanoma 2 Nevi 3. Melanosis oculi	Very malignant	Irradiation if seen in pre-cancerous stage. Exenteration if advanced
Malignant melanoma	Adults 5-6 decade	Cul-de-sacs or scleral triangles	Fixed at limbus moveable in cul-de-sac and over sclera	Localized, elevated pigmented, feathering of pigment along vessels with tufted capillaries supplying clumps of pigment	1 Nevus 2 Cancerous melanosis	Very malignant	Surgical excision and/or exenteration
Lymphomas Lymphoma sarcomas	Any age usually young adults	Cul-de-sac	Moveable on underlying structures	Smooth flat nodular masses, or definite raspberry appearing in the lower cul-de-sac resembling	Generalized disease—blood picture of lymphoid disturbance	Malignant	Irradiation

TUMORS OF THE CARUNCLE

Tumors of the Caruncle are not uncommon and Evans has made an excellent review of the literature in some two hundred cases. The most common of the tumors, grouped according to frequency follow here Papillomas nevi dermoids, or teratoid tumors cysts angiomas carcinomas sarcomas and lymphomas with minor classifications under these main groups depending on the predominating type of cell. Of the seven tumors of the caruncle in this series, three were papillomas, three benign nevi, and one a hyperkeratosis

Treatment and differential diagnosis, as described under the tumors of the conjunctiva apply to tumors of the caruncle

INTRAOCULAR TUMORS

Iris, Ciliary Body Choroid and Retina

Benign Iris Tumors

NEVI

(1 Case) Benign Melanomas of the iris, manifest as pigment freckles are usually noted at ten or twelve years of age and are bilateral in about one-third of the cases (Fig 431) The pigment may be in the stroma or *slightly raised on the surface (Fig 432)* Change in degree of pigmentation or size does not necessarily indicate that the nevus has become malignant but does make it suspicious.

Unilateral pigment freckles according to Reese have been found in eyes in which there was a malignant melanoma of the choroid. These freckles were more elevated and caused increased thickness of the iris. The cells, melanoblasts in type, show more maturity in most cases than do the choroidal melanomas they accompany

Malignant Iris Tumors

There are three main classes of malignant iris tumors The most common is the melanosarcoma second the epithelial tumor of the iris and third the leiomyoma All may contain pigment that makes clinical differential diagnosis impossible

MELANOMAS

(1 Case.) Melanomas of the iris are the most common malignant iris tumors, but they are rare in comparison to choroidal melanomas In this series of uveal tract melanomas the ratio is one to thirty-six Gillset reports one to sixty These are usually of low grade malignancy and occur in a younger age group They are nodular, and increased pigmentation makes them darker than the surrounding iris (Fig. 433A B)



Fig 431 Nevus of Iris



Fig 432. Benign iris cyst

Dilated capillaries course through and around the tumor Clinical differentiation from the benign melanomas depends on the history of increase in size vascularity surface dullness and indefinite irregular edge as seen under the high-power objective of the slit lamp Serial *photographs taken over a period of several* months are important in evaluating the tumor The changes in pigment content do not seem to be indicative of the degree of malignancy of the tumor but are probably the result of pre-

melanin s changing to melanin The rate of growth may be variable but invasion of the ciliary body is usually early producing a secondary glaucoma

The diffuse or ring type melanoma involving iris and ciliary body is very rare These tumors are relatively avascular and of slow growth in comparison with the circumscribed melanoma.

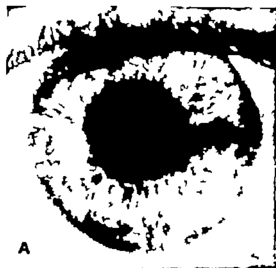




Fig. 433 Malignant melanomas of iris

Pathology Malignant melanomas of the iris present pathology similar to that of choroidal melanomas

Treatment. If the tumor mass is confined to the pupillary margin or mid zone an iridectomy should be done as a primary procedure If the tumor has invaded the angle enucleation is indicated Should the pathological section of the tumor show it to be a leiomyoma or a melanoma spindle cell A or B the eye should be carefully watched for a recurrence If the tumor is a mixed-cell a fascicular or epithelioid-type melanoma the eye should be enucleated. Irradiation has proven valueless in treating melanomas

Technique In doing an iridectomy a cyclodialysis, used to mobilize the base of the iris at the site of the tumor permits wider excision An incision in the conjunctiva and Tenon s capsule is made 8 mm back from the limbus to expose the sclera The sclera is touched with the hand cautery to control bleeding in the area to be incised The point of a Graefe knife with *the sharp side up is inserted just through the* sclera and the cut made outward In this way the chance of injury to the choroid and retina is minimal and less bleeding occurs. The cyclodialysis spatula is passed into the anterior chamber and then swept in an arc to release the ciliary body at the base of the tumor Through a deep keratome incision at the limbus, the iris, together with the tumor is made to prolapse into the wound by pressure on the scleral lip The iris is pulled out farther to give a wide margin of clearance then excised with DeWecker scissors. The conjunctiva over the keratome and cyclodialysis wounds is closed with a plain catgut suture

EPITHELIAL TUMORS

Relatively benign they arise from the posterior iris epithelium and anterior edge of the ciliary epithelium They occur in adults and are usually well circumscribed but not encapsulated and they show slow invasive tendencies The cells vary in the amount of pigmentation and clinical diagnosis from leiomyoma and melanoma is impossible Enucleation was done in the four cases reported by Asbury and no metastases occurred

LEIOMYOMAS

These are malignant tumors of the iris (Verhoeff Frost Ellett) appear as yellowish gray nodules, grow rather slowly and are impossible to differentiate clinically from malignant melanomas They give few symptoms and rarely invade the angle (Dans) The tumor rises from the sphincter and is thus of ectodermal origin

It can be differentiated pathologically from a spindle-cell malignant melanoma by the use of Mallory's connective tissue stain or by a gold impregnation stain to demonstrate myoglial fibers.

Treatment. The tumor is non invasive, and local removal should be tried first performing an iridectomy as just described. If there is a recurrence the eye should be enucleated

HEMANGIOMAS OF THE IRIS

These are extremely rare Rodin reported an iris tumor in a boy of four years which bled intermittently and finally caused a secondary glaucoma necessitating enucleation

LYMPHOMAS OF THE IRIS

So rare are these that only one case of a primary tumor has been reported (McGavic) His patient was alive six years after the eye was enucleated. Pathologically, the tumor could not be differentiated from a lymphosarcoma or a benign lymphoma.

NEUROFIBROMAS OF THE IRIS

Reported by Unger in two cases of generalized neurofibromatosis in von Recklinghausen's disease, these iris tumors were of varied sizes, some were globular and some confluent Their color ranged from café au lait to coffee brown and the nodules were either flat or elevated Except for the pupillary margin nearly all parts of the iris were invaded Diagnosis was made in conjunction with the finding of generalized disease No treatment is suggested

Ciliary Body Tumors

DIKTYOMAS

Also known as Medulloepitheliomas, these are congenital locally invasive slowly-growing tumors of the epithelium of the ciliary body They are usually found in children but one case reported was in a twenty-eight year old man (Sudakoff) When the iris is invaded vision is reduced and secondary glaucoma occurs These tumors have never been known to metastasize

Anderson collected 22 cases from the literature. One of them was a sixteen year-old girl in whose right eye a tumor had been observed since birth In four years it slowly enlarged The vision was reduced to 20/200

"The cornea was normal" he reports, "except for narrow marginal rim of degeneration at two to three o clock. Corresponding to the iris in area twelve to five o clock there was a tumor upper lobe reddish, lower brownish. The surface was irregular slightly papillomatous and richly vascular On the nasal side, the tumor reached as far as the posterior surface of the cornea. Clinical examination gave the impression that the iris was absent corresponding to the area of the tumor"

Pathology Several rows of cells resembling embryonic retina with numerous mitoses were arranged so that the cellular membranes formed cystic cavities but no true rosettes.

Treatment. Enucleation

MELANOMAS

(1 Case.) Occurring more frequently than in the iris, these melanomas are relatively rare (Fig. 434 A and B) They have the same characteristics and the same degree of malignancy as choroidal melanomas.

CYSTIC MELANOMAS

(0 Cases.) These ciliary body tumors are extremely rare, yet their importance should be recognized as clinically they may resemble developmental or spontaneous cysts of the iris stroma, and only biopsy gives adequate diagnosis. Kennedy describes a case in a seventy four year-old white man A small black tumor could be seen in the lower nasal quadrant which filled the posterior chamber between the iris and the lens The anterior chamber was of normal depth except at the lower nasal quadrant where the iris bulged forward The iris was thinned and the crypts appeared dark A small black pigmented crescent shaped area was present in the iris stroma but did not extend to the root of the iris. The tumor mass appeared solid in transillumination Enucleation was done and pathological section showed a cystic malignant melanoma of the ciliary body spindle cell type A

Benign Melanomas of the Choroid

Benign melanomas of the choroid—the so-called blue ointment spots—are flat, blue-grey well-circumscribed areas in the posterior fundus These rarely present a diagnostic problem The size is variable with some occasionally the size of the disc. The overlying retina appears normal the retinal vessels coursing over the

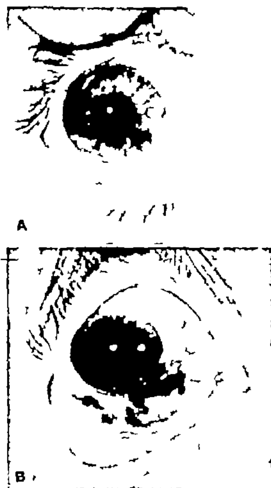


Fig. 434
A. Malignant melanoma of ciliary body with involvement of iris
B Malignant melanoma of ciliary body with extension through the sclera.

spots in a normal manner the choroidal vessels seem to pass through the spots No scotoma can be mapped out There are reports of such tumors taking on malignant growth

Malignant Melanomas of the Choroid

(cases 3,) Malignant melanomas of the uveal tract involve the iris rarely the ciliary body less rarely and the choroid commonly There seems to be some evidence of a familial tendency but no sex specificity Bilateral cases are extremely rare Multiple types of primary neoplasms in one individual are not uncommon (Asbury and Vail)

The average age at which a choroidal melanoma occurs is about fifty years. Symptomatology depends on the location of the tumor If located in the macula the earliest change may be in color values with a poor discrimination for green followed by a hypermetropia and micropsia then a central scotoma (DeJean and Varnier 1934) If the tumor is more peripheral it may grow to considerable size before it causes actual visual obstruction on the other hand a very small tumor may cause a retinal detachment with subsequent field loss and marked visual impairment

In the early stages the tumor may appear as a dark discrete elevated mass or the overlying retina may be oedematous and present a yellowish white elevation which in the later stages may be poorly defined (Fig 435) Transillumination of the eye frequently outlines the mass more clearly than does direct illumination and is therefore one of the most important diagnostic procedures. Hemorrhage around the tumor is reported but in this series it has occurred so infrequently as to be diagnostically significant of an inflammatory process rather than of a tumor

The detachments associated with melanomas are yellowish and without hole or tear They may not necessarily lie over the tumor but may be in the lower segment to which the subretinal fluid gravitates. Thus the extent of the detachment is in no way correlated with the size of the tumor Localized detachments with steep edges do not usually extend to the periphery Secondary glaucoma is so frequently seen accompanying the detachment from tumors that it is felt to be almost diagnostic though the cause of the glaucoma itself remains obscure Pain is rare except in association with an iridocyclitis The appearance of iris freckles may occur in association with the choroidal tumor

Diagnostic withdrawal of the subretinal fluid

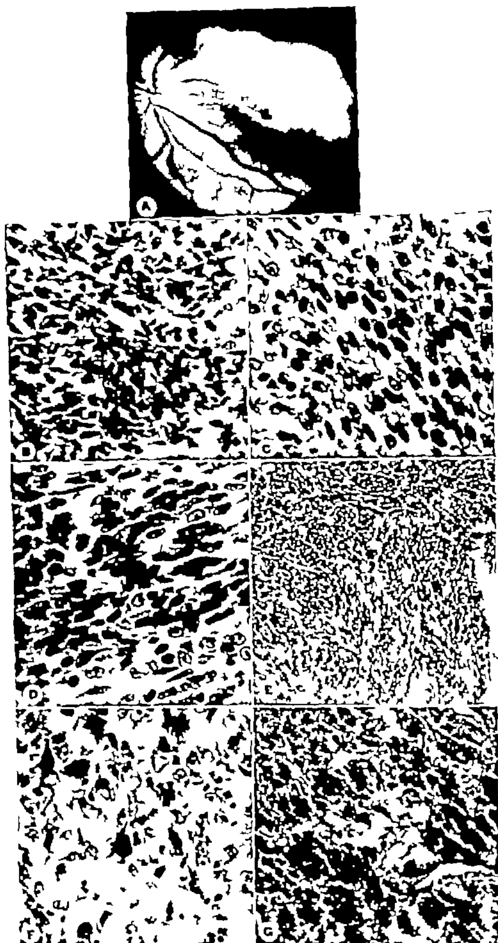


Fig. 435

A. Malignant melanoma of choroid, upper temporal quadrant (Fundus photograph)
B Photomicrograph—spindle cell A Melanoma.
C Photomicrograph—spindle cell B-Melanoma.
D Photomicrograph—mixed cell melanoma.
E Photomicrograph—fascicular melanoma.
F Photomicrograph—epithelioid cell melanoma.
G Photomicrograph—necrotic melanoma. (Classification of Wilder Ash et al.)

for presence of cells is not advised as it rarely aids in the diagnosis Melanin not normally *found in the urine is* diagnostic when it occurs and if it continues after enucleation of the eye is a poor prognostic sign As the tumor grows, invasion of the sclera and penetration along ciliary nerves, vessels and vortex veins frequently develops *Involvement of the retina is* late Metastases, blood borne to liver lungs and other organs may occur early or they have been known to develop fourteen years after enucleation

TABLE 33

FIVE HUNDRED CASES OF CHOROIDAL MELANOMAS FOLLOWED FIVE YEARS

Callender Wilder and Ash

Outcome According to Cell Type

	LIVING	DEAD	TOTAL	PER CENT DEAD
Spindle A	33	2	35	6
Spindle B	88	29	117	25
Fascicular	8	5	13	38
Necrotic	23	22	45	49
Mixed	105	171	276	62
Epithelioid	4	10	14	71
Total	*261*	*239*	*500*	*48*

Outcome According to Argyrophil Fiber Content

	LIVING	DEAD	TOTAL	PER CENT DEAD
Heavy	17	2	19	10
Marked	58	32	90	36
Medium	80	63	143	44
Light	101	122	223	55
Absent	5	20	25	80
Total	261	239	500	48

In the past ten years at the Wilmer Institute there have been thirty-seven melanomas of the uveal tract One of these tumors was in the iris one in *the ciliary body and thirty five in* the choroid Three were spindle cell Type A three spindle cell Type B twenty nine mixed one epithelioid and one necrotic Of the thirty seven cases only ten could be followed for five years or longer Five patients lived and were apparently well five died before the end of this period. These Wilmer cases were included in the extensive work of Callender Ash and Wilder who found a 48% death rate in five hundred patients followed for five years and a *66% death rate in patients followed ten years.* Although their mortality according to cell type and reticulin fiber count of these five hundred cases is given they were unable to establish definite correlation between pigment content and malignancy (See Table 33)

MacGregor and Hill reviewed eighty two cases of malignant melanoma and were in complete agreement with Callender Ash and Wilder that a full reticulin content indicates a good prognosis, and that the spindle cell types A and, to a lesser extent B are relatively benign The epithelioid and mixed-cell types with low reticulin content indicate to the contrary a poor prognosis It is generally agreed that the stage of the disease in which diagnosis is made and enucleation carried out is not so important in the prognosis as are the individual cell type and the reticulin content of the tumor Even extraocular extension through the sclera does not alter this concept

Pathology *Callender's grouping follows* (1) *Spindle cell A* spindle-shaped cells with narrow oval nucleus and indistinguishable or ill-defined nucleolus. (2) *Spindle cell B* spindle-shaped cells in which the nucleus is also oval, but which has a prominent nucleolus and is generally more robust than in spindle cell A (3) *Fascicular* a palisaded arrangement of the cells, which are usually spindle-cell type B (4) *Necrotic* too necrotic to classify (5) *Mixed cell tumors* a combination of two or more types with the exceptions of spindle cell A and B type tumors (which are classed as spindle cell B) and spindle-cell type B in palisaded arrangement (which are classed as fascicular) (6) *Epithelioid* a round or polygonal cell usually *rather large but with considerable variation in* size and shape The nucleus is large round and nucleolated. The cytoplasm is abundant and markedly acidophilic The least malignant type

is the spindle cell A, and the most malignant is epithelioid When cases are classified according to argyrophil fibers, as demonstrated by Wilder's reticulin stain the malignancy is inversely proportional to the fiber content

Differential Diagnosis.

Melanomas are usually singly pigmented lesions that, upon transillumination, appear as a dark mass Often they cause a retinal detachment and secondary glaucoma without a hole formation Melanin may be excreted in the urine and is diagnostic. They must be differentiated from

1 An inflammatory choroiditis which often has old associated lesions in the same or in the other eye. Hemorrhage is frequently seen. There are usually other signs of inflammation present, such as a positive aqueous ray and Keratitic precipitates, vitreous floaters, and a low grade cyclitis with ciliary injection (Fig 436)

2. Choroid angioma which cannot be clinically differentiated, unless associated skin lesions of nevus flammeus or other abnormalities are present

3 Metastatic choroidal tumors which may be either bilateral or multiple in the same eye. Yellowish white in color they are located in the posterior fundus, grow rapidly and commonly are associated with retinal hemorrhages (Fig 437)

Inflammatory lesions may be single but they often show evidence of bilateral involvement and of previous lesions Retinal or subretinal hemorrhages and other inflammatory signs may be present.

Degenerative lesions are usually multiple No detachment or inflammatory signs are present and no mass is seen on transillumination

Simple Detachment occurs with a hole, a tear or dinsertion and usually tension is low

Metastatic tumor which may be multiple, is usually posterior and diffusely spread The color is grey white with little or no pigment Frequently pain is a presenting symptom, hemorrhages and detachment are common The history of a primary tumor elsewhere is almost diagnostic when considered with the above picture

Treatment. The diagnosis of malignant melanoma of the choroid calls for immediate enucleation removing as much optic nerve as possible. If the tumor has penetrated the globe,

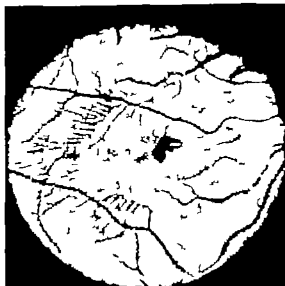


Fig 436. Hemorrhage beside pigmented inflammatory lesion—to be differentiated from early melanoma.

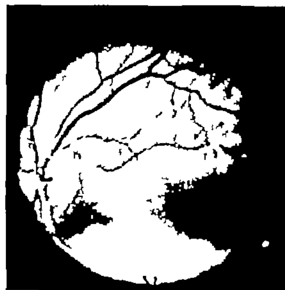


Fig. 437 Metastatic carcinoma to choroid below In this patient metastases were also to the orbit. Pressure striae of the retina are well shown

exenteration should be carried out immediately (See technique under orbital tumors.)

Irradiation is of no value either in the primary or secondary growth

Diathermy Coagulation (Technique as under diathermy punctures for angiomatosis retinae) of the melanoma in an only eye of an elderly

person is justified as an attempt to save even a small amount of vision as long as possible

Metastatic Tumors of the Choroid

Metastatic tumors of the choroid are not uncommon (Fig 437) Since they are usually blood-borne they are bilateral in almost twenty five percent of all cases are posteriorly situated and are more often in the left eye Involvement of the iris and ciliary body is relatively rare The most common primary site is the breast and the second the lungs cases have been reported also from the lips, abdominal wall testicle prostate and rectum The ophthalmoscopic picture of the metastatic tumor is very different from that of a malignant melanoma. The tumor is a white, or yellowish-gray elevated patch at first circumscribed then becoming diffuse it spreads out in a fan-shaped manner toward the periphery The surface is *definitely mottled with ill-defined edges, and* small hemorrhages are very common Growth increase is relatively rapid and retinal detachment occurs The fact that the growths are often multiple and that they are located in the posterior pole is of diagnostic importance. Pain is frequently present

Pathology This is dependent on the nature of the primary growth which shows considerable variation. Often clumps of tumor cells are found within the vessels.

Treatment. The prognosis is bad and treatment is only palliative If the eyes give pain enucleation must be performed Occasionally irradiation will slow down the process and relieve the pain though this depends on the original type of tumor

Neurofibromatosis

(2 Cases) Neurofibromatosis of the choroid is usually associated with von Recklinghausen s disease Two cases occurred in autopsy specimens in this series which had not been clinically diagnosed

Angiomatosis

(Cases 2) Angiomatosis of the choroid is a rare tumor which may be seen as an isolated clinical lesion. However it is more often encountered as the Sturge-Weber syndrome associated with the nevus flammeus of the skin situated in an area innervated by a branch of the trigeminal nerve with angiomatous lesions of the meninges and cerebellum Areas of intracranial calcification can be demonstrated by x ray Convulsions and varying degrees of mental retardation are common

The eye picture is usually secondary to the associated glaucoma The episcleral and conjunctival vessels are dilated and there is tortuosity of the retinal vessels The diagnosis however is more often clinically suspected on the basis of associated skin and intracranial lesions. Diagnosis is confirmed when the eye is enucleated for absolute glaucoma

One case of this series presented the typical picture of nevus flammeus calcification in the cerebellum and an absolute glaucoma The eye *was enucleated because of pain and on pathological section* a choroidal angioma was found.

The second case had progressive loss of vision without any of the associated skin or cerebral lesions but a secondary glaucoma was present The retina in this case showed a localized detachment which transilluminated poorly In the choroid a dark mass could be seen which was clinically diagnosed incorrectly as a melanoma The eye was enucleated

Differential Diagnosis. The isolated angioma of the choroid may not be clinically differentiated from a melanoma

Pathology A typical cavernous type of angioma is found in the choroid

Treatment. Enucleation

Tumors of the Sclera

Tumors of the sclera usually an extension or infiltration from an adjacent tumor are extremely rare Melanomas are the most frequent offenders in this instance though squamous-cell carcinoma and mixed tumors of the lacrimal glands are sometimes responsible Dermoid involving conjunctiva sclera and choroid are also reported (Carter)

Thirteen of the fourteen tumors in this series that had invaded the sclera were from choroidal

melanoma one was a carcinoma of the lids and orbit

Tumors of the Lens

Tumors of the lens have not been reported

Tumors of the Retina

Anderson's chart (Table 34) suggesting close relationship in the origin of most retinal tumors is helpful in understanding these tumors as they are clinically encountered The retinoblastoma, while the most undifferentiated, is by far the commonest and in general the most malignant The neuroepithelioma is a more differentiated type of tumor with origin in the neuroepithelium This is less common than the retinoblastoma and perhaps, slightly less malignant Astrocytomas are true gliomas and relatively benign. Tumors of the ciliary epithelium—the medulloepitheliomas—are extremely rare and relatively benign These will be discussed under tumors of the ciliary body

RETINOBLASTOMAS AND NEUROEPITHELIOMAS

Clinically undifferentiated these are, therefore, discussed together These tumors have been improperly called retinal gliomas They are probably of congenital origin and in most instances are discovered before the third year However occurrence in older children and even in adults has been reported (Rasmussen) No sex specificity has been noted but a marked hereditary factor (Benedict et al) is known and eugenic prophylaxis should be stressed They are bilateral in about twenty percent of the cases and the tumor in the second eye may appear at any time from a few weeks to several years after the first There is no extension or connection between the two tumor masses but two distinct sites of origin The tumor is not as frequently found in colored people as in white

The usual first signs of the tumor may be one or all of the following a yellowish-gray or white reflex in the pupillary space (Fig 438A) a dilated pupil or a definite squint The tumor extends by local invasion and the eye is gradually filled all structures ultimately becoming involved (Fig 438B) Growth is so rapid that it often outstrips the blood supply forming areas of necrosis. Secondary glaucoma occurs if the drainage channels are blocked by tumor cells. Occasionally a hypopion of tumor cells seen in the anterior chamber may be confused with an acute inflammatory process (Bedell)

The most striking ophthalmoscopic picture presented by this tumor is a gray mass of cells with characteristic daughter, or satellite new growths scattered throughout the vitreous or over the retina Small chalky white areas are seen and these show up by x ray as calcium deposits in seventy five percent of the tumors (Pfeiffer) This condition is not found in the pseudogliomas or congenital anomalies Enlargement or erosion of the optic foramen as shown by x ray, is indicative of tumor extension along the optic nerve Extraocular extension also may occur along the perforating scleral vessels

Twenty three cases of retinal tumor were studied in this series sixteen retinoblastomas four neuroepitheliomas, and three pseudogliomas. Twenty-one were in white patients and two in colored one pseudoglioma was unilateral and followed a questionable history of injury and two were bilateral Of the sixteen cases of retinoblastoma two were bilateral In one child there was hopeless involvement of both eyes and bilateral enucleation was done, with the enucleation of the second eye taking place one week after the diagnosis had been confirmed in the first eye Both orbits were then irradiated according to Reese's recommendation The child has continued well during the one and one-half years to date. The second child had the first eye enucleated and the second eye irradiated This tumor was at first not controlled and a total dosage of 22,000 r was given Vision was completely lost, but the child has remained well during a follow up of four years.

Two bilateral cases in the neuro-epithelium group were found One child died on the operating table and, at autopsy, was found to have generalized metastases In the other child the worst eye was enucleated and the second

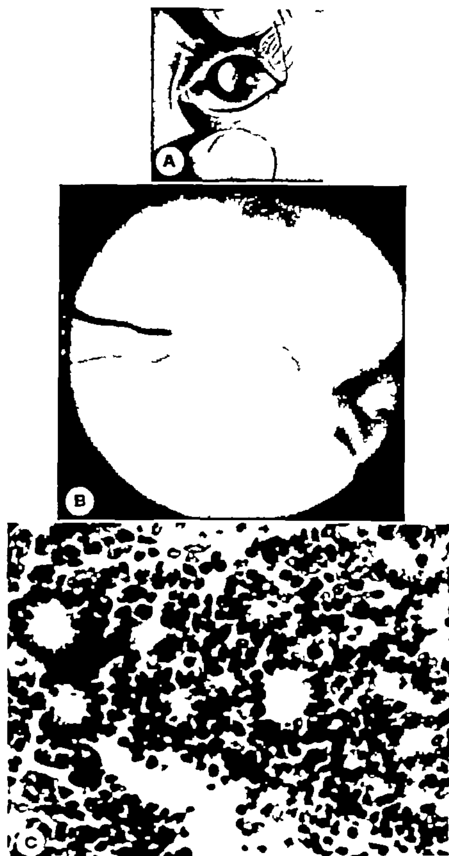


Fig. 439

A. *Retinoblastoma showing white pupillary reflex*
B. Retinoblastoma (Fundus photograph)
C. Photomicrograph

treated by Reese. Vision of 10/200 has been saved and there has been no recurrence to date, four and one half years later.

Among the sixteen unilateral cases, there were five deaths. Two children already had intracranial extension when first seen. In one child tumor cells were found in the nerve and a secondary transfrontal approach was done to remove the remaining nerve as far back as the chiasm. In spite of this the child died in four months from local recurrence and intracranial extension.

In two children the nerves were free of tumor cells on section, but there was a discontinuous spread which caused local recurrence and intracranial extension. Deaths took place in one and three years respectively. Neither of these children had received prophylactic, postoperative orbital irradiation.

Five children could not be observed postoperatively. Of the nine that were followed, five were alive and well four years after operation, one two years and three one year.

Thus, of the twenty patients with retinoblastomas and neuroepitheliomas there was a known mortality of thirty percent. Since five cases could not be followed the presumptive mortality would increase this figure. In the group here described bilateral tumors did not change the prognosis.

Differential Diagnosis.

1. *Pseudogliomas* following an inflammatory process or injury are stationary lesions. The white reflex is of more even texture without the satellite masses or calcium deposits. In eyes with this condition the tension is very low.

2. *Retrolental fibroplasia* occurring three to eight weeks postnatal in premature infants weighing less than four pounds at birth shows a shallow anterior chamber, prominent ciliary processes and varying degrees of retinal detachment. In advanced cases the retina is forced against the posterior surface of the lens.

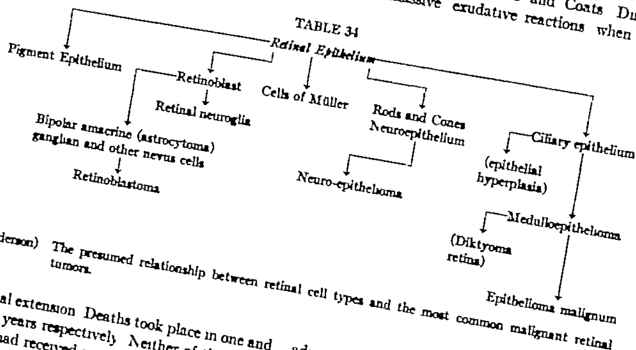
3. *Angiomatous retina* and Coats Disease with massive exudative reactions when far advanced are difficult to tell from retinoblastoma. The vitreous is usually not so much involved, and no satellite tumors are present.

4. *Congenital Defects*—microphthalmos with retinal folds and glial proliferations—all may be difficult to differentiate clinically from early retinoblastoma.

Pathology

1. *Retinoblastomas* are composed of closely packed round-cells, or retinoblasts with large darkly-stained nuclei. The cells show many mitotic figures and a pseudorosette radial arrangement around the blood vessels. Degenerative changes with areas of necrosis and hemor

TABLE 34



(Anderson) The presumed relationship between retinal cell types and the most common malignant retinal tumors.

rhage occur as the tumor outgrows the blood supply (Fig 438 C)

2 *Neuroepitheliomas* have cells that form true rosettes around a central cavity which contains colloid or hyalin material but no blood vessels. The nuclei lie away from the cavity Between the rosettes are masses of round cells with large nuclei and scanty cytoplasm. Necrosis and degenerative changes are frequently seen.

3 *Astrocytomas* are true gliomas and extremely rare Such a tumor was reported by McLean in 1937 from the Wilmer files. It occurred in a woman of twenty three as a sharply-defined highly vascularized mass in the macular area without satellites or a disturbance of any of the other ocular tissues The tumor confined to the retina, arose from the inner nuclear layer and was composed of long spindle cells with ovoid nuclei which differential staining showed to be neuroglial cells. Mitoses were few and the tumor was felt to be relatively benign A case of oligodendroglioma was reported by Huggert and Hultquist.

Treatment. 1 Unilateral retinoblastomas require immediate enucleation with removal of at least one centimeter of nerve The insertion of a ball implant is not advised as it may interfere with the effectiveness of postoperative irradiation Extension along the nerve occurs in about eighteen to twenty per cent of the cases either as a direct or discontinuous spread and it is extremely important that every orbit be irradiated postoperatively even though no tumor is found in the nerve This point cannot be over-emphasized since two patients in this series died because of a discontinuous spread along the nerve when irradiation might possibly have saved them. Reese recommends 7000–9000 r given directly into the orbit in the A.P direction over three to four weeks time Successful eradication of the tumor occurred in sixty six per cent of the cases where the nerve had already been involved (Reese)

McLean and others have advocated as a primary procedure the intracranial approach to sever the optic nerve anterior to the chiasm Several days later enucleation is done and the nerve pulled anteriorly through the canal The objection to this procedure is obvious in that it subjects about eighty percent of the children to an unnecessary intracranial operation.

In unilateral cases it is extremely important to examine the second eye at two- to three month intervals, with the pupil widely dilated and the child under anesthesia, if necessary In this way only can early tumors in the second eye be discovered and irradiation therapy started early

2 A. If in bilateral tumors the involvement is so extensive that the possibility of saving any vision in the best eye is remote the worst eye should be removed and both orbits irradiated Some ophthalmologists feel that the removal of the second eye is never justified but that heavy irradiation should be substituted in an attempt to sterilize the tumor (Walsh)

B When there is vision in the better eye of a bilateral case the eye that is worse should be enucleated to confirm the diagnosis, and the good eye then irradiated according to technique of Martin and Reese

Technique. For this two special cylinders are used One has an oblique distal end to fit against the temple the second has a hook to fit over the bridge of the nose and mark the margin of the beam, so that the cornea and the anterior chamber of the eye are not hit The factors 220 K V 20 milliamperes target skin distance 50 cm filter 0.5 copper and 1 0 mm aluminum temporal portal 2.5 cm nasal portal 2 0 cm Position of portals (1) temporal directed transversely (2) nasal directed obliquely Frequency of treatments three times a week A single dose is 400 r alternating portals at each treatment maximum total dosage 8000 r times two Less than 7400 r times two was found to be unsatisfactory When 8000 r times two did not obtain results the eye was enucleated for increased irradiation did not control the growth and frequently caused degenerative changes with secondary glaucoma and phthisis.

Small tumors that were not elevated gave the best results. Failure occurred in large elevated tumors with many satellite lesions and also when the choroid was invaded Cataracts

developed in six of the fifty three cases as a result of therapy More serious than the cataracts was a secondary glaucoma in nine cases, causing the loss of the eye in seven In one case a rhabdomyosarcoma of the temporal muscles developed as a result of irradiation, and the patient died

Of fifty-five patients treated by Reese Merrian and Martin fifty three have been followed Twenty five or 47.2 per cent are living with vision of 20/200 or better, 16 or 30.2 per cent are living without vision, and twelve or 22 6 per cent have died of retinoblastoma

Nineteen have been followed five years or longer Of these 31 6 per cent are living with vision of 20/200 or better, which is a remarkable proportion 31.6 per cent are living but blind and 36.8 per cent have died of the disease

Radon seeds (1-2 mc in 0.5 platinum) have been used with some success by Stallard (1938) and by Waldman and Shannon.

PHAKOMATOSES (BIRTH MARK)

Under the heading of phakomatoses Van der Hoeve included four syndromes Angiomatosis retinae, with associated lesions, Von Hippel Lindau syndrome Angiomatosis of choroid with associated lesions, Sturge Weber syndrome Neurofibromatosis retina with associated lesions von Recklinghausen syndrome and tuberous sclerosis retinae with associated lesions Bourneville syndrome The inter relationship of these diseases is manifest when the chart of Van der Hoeve is studied. (See Table 35)

ANGIOMATOSIS RETINAE

A congenital tumor this is associated with similar tumors of the cerebellum spinal cord, pancreas, liver and kidney so that the symptomatology of the syndrome is legion Von Hippel described the retinal lesion in 1904 and reported twenty percent of the cases had intra cranial complications

Lindau in 1926 called attention to the frequent retinal lesions in cases with angioblastomatous cysts of the cerebellum and thus occurred the confusion in terminology Lindau s disease is generally considered to be on the basis of a true tumor rather than on that of a congenital anomaly and it occurs as a cerebellar hemangiomatous cyst with associated tumors. The disease is essentially a neurosurgical problem, for the retinal lesions occur in only a very small percentage of the cases. When they do occur the picture is typical of angiomatosis retinae as described by Von Hippel

Angiomatosis retinae is bilateral in almost one third of the cases, and males are more frequently affected than females. The age ranges from early childhood to the sixth decade but is most often found in the third decade Heredity plays a part in the picture as shown by Von Hippel's first case of this sort in which the son and daughter of the patient had retinal lesions Later the daughter died of a cerebellar cyst

The first complaint is a visual loss which comes suddenly with macular involvement, or slowly with peripheral involvement (Fig 439 A and B) The angiomas are usually located in the extreme periphery of the retina. The blood in the dilated arteries and that in the tortuous veins supplying the lesion appear about the same in color The tumor appears as a clump of dilated tufted vessels Often however the retinal lesion is obscured by an exudative reaction Subretinal fluid and exudate causes macular involvement and localized detachments. All varieties of lesions—papilloedema hemorrhages massive gliosis and macular stars—have been described as present, depending upon the abnormal and altered blood supply

Differential Diagnosis.

1 The most difficult differential diagnosis is from Coats disease in which there is also a massive exudative reaction In advanced stages when angiomas cannot be seen, the differential diagnosis is impossible

2 Multiple aneurysms of the arteries are rare, but when present they appear as localized dilations of the arteries.

3 Pseudo-gliomas of the retina which are usually present in younger patients may present a confusing picture in these the eyes are

often soft and give history of injury or inflammatory phase.

TABLE 35

PHAKOMATOSES (VAN DER HOEVE)

	BOURNEVILLE	RECKLINGHAUSEN	VON HIPPEL LINDAU	STURGE WEBER
Nervous system	Cerebrum: swelling in the cortex; ependymal tumors; cerebral tumors; cysts	Cerebrum—glioma Brain nerves, Spinal nerves, Sympathetic: tumors: ganglioneuroma; neurofibroma	Cerebrum—angioma Cerebellum, Medulla: angioplastic tumors; cysts glial proliferation Oblongata Spinal cord—glioma Syringomyelia	Meninges—nevi vasculosi Cerebrum: atrophy; calcifications; cerebral tumors Cerebellum—atrophy
Eye	Choked disc Disc and—cysts and—neurofibrilloma Retina—tumors—neurocytoma	Disc: choked disc; regeneration and glial proliferation Retina: cysts; tumors with antiomatous areas; degeneration Optic nerve: tumors; atrophy Buphthalmos Exophthalmos	Disc: choked disc; angioma Retina: angioma; gliosis; cysts; degenerations	Choroid: vessel proliferation; angioma Retina—glioma Buphthalmos Glaucoma
Other organs	Cardiac rhabdomyoma Kidney: cysts; tumors: hypernephroma, leiomyoma, fibroma, lipoma Uterus: fibroma; leiomyoma Intestine—lipoma Nipples, Thyroid: adenoma Skin: nevi and other spots; tumors: adenoma, fibroma, -gioma, lipoma	Thorax—tumors Abdomen—tumors Bones: cranial defects; diseases and softening of vertebral column; cysts; tumors Endocrine glands—various softenings Skin: nevi etc; tumors	Kidneys: cysts; hypernephroma Pancreas: cysts; cystadenoma Ovaries—cystadenoma Suprarenal, Capsule, Epididymis: tumors Skin: nevi; angioma Syringomyelia	Endocrine glands: acromegaly; adiposity Skin—nevus flammeus
Special symptoms	Epilepsy Idiocy Imbecility	Epilepsy		Epilepsy, Idiocy, Imbecility: paralyses

4. Racemoses arteriovenous aneurysm which is extremely rare may be confused with early stages of angiomatosis retinae.

Pathology The capillary and cystic vascular dilatations are frequently overshadowed by a massive glial and exudative overgrowth The retina is usually detached Diagnosis depends on the section through the dilated blood spaces of the tumor mass.

Treatment. Good results have been obtained with early cases in this series by occluding the vascular tumor with penetrating diathermy

using either Walker pins or Kronfeld needles The same technique is employed as for retinal detachments, except the barrage is more concentrated Some have used surface diathermy in addition to penetrating diathermy (Lewis, Keys) Radon seeds are also reported to be effective (R Foster Moore) X ray has not been too successful (Cordes and Hogan)

The choice of therapy depends first on the availability of the tools. Generally the application of surface or penetrating diathermy is more convenient and satisfactory than the insertion of radon seeds It must be emphasized that in advanced cases with extensive macular involvement the globe may be saved, but visual return is usually not accomplished even though the tumor is destroyed

In cases with secondary glaucoma, enucleation is the only recourse.

Technique. Barrage of Angioma of Retina (Anaesthesia Van Lint lid injection 2 cc. retrobulbar injection as described)

A Parke speculum gives the best exposure for intraocular and bulbar work and it is used routinely The eye is grasped with fixation forceps opposite the site of the tumor and rotated to give the best scleral exposure over the tumor site The conjunctiva and Tenon s capsule are opened 15 mm. back from the limbus and the sclera is then exposed All bleeders should be touched with the diathermy to give a perfectly dry field The recti muscles can be retracted sufficiently for easy placement of pins, and oblique rotation of the eye increases the exposure Four Walker pins are placed in the sclera in the form of a rectangle over the supposed site of the tumor and the retina is observed with an ophthalmoscope to check on the location Using this spatial guide the whole tumor area is heavily barraged giving a wide margin of overlap in coverage.

The conjunctiva is closed with interrupted five-0 plain catgut and the eye dressed with atropine.

Postoperatively considerable intraocular reaction may occur which takes six weeks to two months to subside In many cases the absorption of subretinal exudates takes even longer

TUBEROUS SCLEROSIS (BOURNEVILLE S DISEASE)

In this congenital syndrome the eye plays a part in a general picture of multiple tumors with the retina, skin and brain involved Clinically, the most outstanding sign is the adenoma sebaceum of the face in butterfly distribution



Fig 439
A. Angiomatosis retinae B showing exudates in macular area and along vessels.

over the nose and cheeks Often it is associated with mental deficiency and epilepsy As in angiomatosis retinae heredity seems to be important (Messinger, H C and Clark) Siblings may have single lesions and not the complete syndrome

The tumor of the retina is nodular when seen near the disc and flat or oval when seen

peripherally These frequently show calcification as demonstrated by X ray They may be single or multiple Such tumors remain static and are of diagnostic importance only

Associated with the adenoma sebaceum are nevi and the café-au lait spots of neurofibromatosis.

The cerebral lesions occur as tumors in the walls of the third and lateral ventricles in addition to other parts of the brain and cord Calcium deposits in these show up on X ray

Differential Diagnosis. Tuberous sclerosis of the retina must be differentiated from

(1) Drusen at the disc (Fig 440) which do

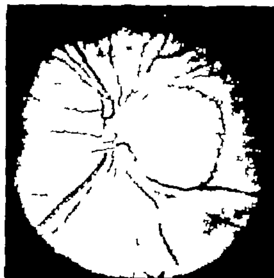


Fig. 440. Drusen at the disc to be differentiated from tuberous sclerosis.

not contain calcium or have any associated anomalies.

Pathology The retinal tumors occur in the nerve fiber layer and are composed chiefly of hyalin material, in which there are frequently areas of calcification The cellular element is large and polymorphic, with round nucleus and prominent nucleolus The cell boundary is indistinct. It is felt that they are an embryonic glial type

Treatment. None

NEUROFIBROMATOSIS

A congenital tumor syndrome with definite heredity features this is associated with the generalized von Recklinghausen s disease (See description under Lid Tumors.) The retinal tumors appear very similar to those of tuberous sclerosis and frequently involve the nerve head. When the lesion is peripherally located and diffuse the diagnosis is suspected but is rarely made clinically The associated defects of this syndrome are described fully under tumors of the lids.

METASTATIC TUMORS

Metastatic tumors of the retina are extremely rare Uhler reported a melanoma of the skin that metastasized to the retina A metastatic lesion from a carcinoma of the gastrointestinal tract has also been reported by Somoleroff and Agatston

TUMORS OF THE ORBIT

Orbital Tumors in contrast to other tumors of the eye and adnexa, have this in common A presumptive diagnosis can be made on the basis of six millimeters of unilateral exophthalmus For a differential diagnosis, the usual bases will be more fully discussed than previously

Age of Patient. In children congenital benign tumors are by far the most common but we must consider the malignant sarcomas, the metastatic tumors, and tumors of the lymphoma group

In adults about half of the orbital tumors are malignant.

Rate of Tumor Growth. As earlier stated, in children congenital benign tumors usually enlarge slowly and malignant tumors enlarge very rapidly

In adults benign tumors, as the pseudotumor and some malignant tumors of the metastatic and lymphoma group enlarge rapidly whereas other malignancies, such as mixed tumors of the lacrimal gland enlarge slowly

Tumors that lie deep in the orbit may cause an absorption of orbital fat and produce exophthalmus less rapidly than tumors anteriorly located or those lying against the orbital wall

Location. Primary orbital tumors have their origin in the orbit itself and their specific loca

tion is of diagnostic importance. Secondary orbital tumors may originate in structures adjacent to the orbit or they may be a part of a generalized disease with remote origin Orbital dermoids and lacrimal gland tumors are most frequently found in the upper temporal quadrant Angiomas mucoceles, pyoceles, and osteomas occur in the upper nasal orbit. All of these produce a lateral or vertical displacement of the globe, while tumors of the muscle cone and apex of the orbit gliomas and meningiomas, produce an axial exophthalmus.

Palpation. Angiomas lymphomas, and lipomas are all soft and compressible permitting the eye to be pushed backward into the orbit In contrast, malignant tumors, pseudotumors, and the malignant exophthalmus of thyroid disease are firm and non-compressible In anteriorly located tumors the mass itself may be palpated, thereby indicating the degree of encapsulation fixation or invasion.

Auscultation. The presence of a bruit is considered diagnostic of aneurysm but lack of a bruit does not rule out such a possibility

Mobility Interference in mobility, as indicated by diplopia suggests infiltrative invasion of the muscle This occurs when muscles are invaded in malignancies pseudotumors, and malignant exophthalmus.

Visual Disturbances. Pressure on the globe itself in the case of muscle cone tumors may cause gradual hyperopia Tumors in the muscle cone also produce early visual loss and bizarre field defects by pressure or invasion of the optic nerve.

X-ray evidence. Pfeiffer in a study of two hundred cases of orbital tumors, found that diagnosis could be made in 42 per cent of them by x ray alone Increased soft tissue density with pressure thinning and atrophy of bone, was demonstrated in these in addition to dehiscences fossae bone erosion and enlargement of the optic canal According to him congenital tumors hemangiomas, dermoids and neurofibromas may all also be associated with fossae though in fossae the cortex of the bone extends uninterruptedly, in distinction to that of bone erosion or invasion In meningiomas, gliomas, retinoblastomas and neurofibromas of the nerve, the optic canal is enlarged or eroded

Hyperostoses are typical of meningiomas, especially along the sphenoidal ridge and these must be carefully differentiated from osteomas in the sphenoid region Occasionally, the bony overgrowth produced by a meningioma is difficult to differentiate from localized Paget's disease or fibrous dysplasia (Walsh)

Of the one hundred twelve orbital tumors collected by Day from the Wilmer records, 1937–1948 sixty nine were primary in the orbit thirty-three were secondary from structures adjacent to the orbit, and ten were secondary from structures of remote origin These figures roughly parallel the incidence of primary to secondary tumors in other clinics. Primary orbital tumors will be discussed in detail secondary orbital tumors will be discussed in relation to their differential diagnosis and disposition

Among the sixty nine primary orbital tumors, thirty were first noted or had a history of occurrence during childhood Of these, twenty-six were benign and four were malignant sarcomas. Of the thirty-nine primary tumors noted in adulthood twenty-one were benign and eighteen were malignant Of the benign tumors, the pseudotumor was most frequently seen of the malignant, the mixed tumor of the lacrimal gland was the most common.

Primary Benign Tumors of the Orbit

Angiomas

(14 Cases.) Common congenital orbital tumors related to capillary telangiectases and arterio-venous aneurysms these are most frequently noted early in childhood but, if situated deep in the orbit they may escape observation until the time of puberty or even later when enlargement occurs. Growth is usually rather slow and often becomes self limited in older patients though not before a great deal of pressure damage and distortion of tissues has occurred

These tumors most frequently occupy

upper nasal quadrant but they may occur in the muscle cone or anywhere in the orbit When the conjunctiva and lids are involved the diagnosis of the red tumor mass is not difficult, for it becomes turgid on crying or straining (Fig 441 A and B) The tumor mass *is soft and the orbital* contents compressible. Angiomas located in the muscle cone frequently cause decrease in visual acuity papilloedema and venous engorgement. In rare



Fig 441

A. Angioma of orbit and face
B Angioma post x-ray therapy

instances a bruit is heard on auscultation X rays of the orbit may show fossae or dehiscences in the bone in addition to the soft tissue mass

Diagnostic response to x ray therapy is extremely important and all slow-growing tumors in children merit the short period of six to eight weeks for a diagnostic course 1200–1600 r No harm can occur from this procedure when small portals are used and the globe is adequately shielded Should the tumor prove to be an angioma then a needless operative procedure will have been avoided

Some angiomas are well encapsulated and contain a predominant amount of fibrous tissue This group presents symptoms later in childhood or even in adult life

Differential Diagnosis.

Angiomas must be differentiated from

(1) *Dermoids* which do not respond to x ray are usually situated in upper temporal quadrant of the orbit, and may be closely attached to bone, causing pressure atrophy Calcium deposits in these tumors may *also* occasionally be demonstrated by x-ray (Pg 551)

(2) *Neurofibromas* which have associated congenital defects. Pulsation because of defects in orbital roof may be confusing but the defect is easily demonstrated by X ray (Pg 552.)

(3) *Gliomas* of the optic nerve which produce early visual disturbances followed by axial exophthalmus and are not sensitive to x ray (Pg 557)

(4) *Arterio-venous aneurysms* which usually have an associated bruit and have a definite time of onset occur more frequently in adults. (Pg 566.)

(5) *Sarcomas* which have a rapid growth, are hard, and invasive of orbital tissues and bone (Pg. 559)

(6) Mixed tumors of the lacrimal glands, which occur usually in adults, are slow-growing non-compressible, invasive, and not radio-sensitive (Pg 561)

(7) *Mucoceles and pyoceles* which usually lie in the upper nasal quadrant of the orbit (Fig 442) X ray reveals a cloudy sinus and often a dehiscence in the ethmoid or frontal plate.



Fig 442 Mucocele of ethmoids

Treatment. X ray therapy using small portals that can be carefully directed with adequate shielding of the globe, is by far the most satisfactory method of treating angiomas in children It is well known that the earlier in life the angioma is treated the more dramatic, the response This is in accord with the general principles and knowledge regarding ray therapy

In adults occasionally the angiomas are resistant to ray therapy The tumor mass is usually encapsulated in these cases and surgical removal does not present a difficult problem.

Good results from the injection of 0.5 cc. to 2 cc of 5 per cent sodium morrhuate solution have been reported but have not been used in this clinic.

LYMPHANGIOMA

(0 Cases) Rare orbital tumors resembling cavernous hemangioma except that the endothelial spaces contain lymph, they are congenital and are clinically undifferentiated from angioma

Treatment Excellent results are reported with x ray therapy

TERATOID TUMORS

(7 Cases) *Dermoids* are relatively common benign congenital tumors most often noted early in childhood or at puberty (Fig 443) The enlargement is usually gradual but it may have spurts of growth followed by long periods of quiescence. The tumors are most frequently



Fig. 443 Dermoid left orbit attached to periosteum of temporal bone

found in the upper temporal quadrants of the orbit usually close to the orbital wall either attached to, or in contact with the periosteum. They may be solid or cystic and some are lobulated with ramifications in the orbital fat Pressure may cause retinal folds, papilloedema, and optic atrophy, bone erosion may also occur

Calcium deposits in the dermoid itself can frequently be demonstrated by x ray Dermoids are not radio-sensitive

Differential Diagnosis Dermoids must be differentiated from

(1) Angiomas
(2) Neurofibromas
(3) Sarcomas
} See differential diagnosis under *Angioma* (Pg 549)

Pathology Similar to dermoids of the lids. (Pg 551) Dermofibroma and Dermolipoma

are pathological sub-classifications to indicate a *predominance of fibrous or fatty tissue*

Treatment. Surgical removal of orbital dermoids is usually done through a brow incision.

Technique An incision is made in the brow at the lower edge of the hair line and is carried down to the periosteum which is incised along the orbital rim With a periosteal elevator exposure is obtained as far back as the tumor mass An incision is then made in the periosteum at the tumor's site Very little bleeding



Fig 444 Retrobulbar cyst

is encountered Since the dermoid may be attached to or lie near the periosteum it can be removed with minimum trauma If cystic, care should be taken not to rupture the sac, as the contents are often irritating and cause postoperative reaction If it is impossible to deliver the dermoid intact its contents should be aspirated and then removed Deep sutures are unnecessary The skin is closed with a subcuticular dermalon suture and the eye dressed with an elastic pressure bandage

(0 Cases) *Cholestealomas* are rare congenital teratoid tumors which produce a low grade exophthalmus (Constans) They have no inflammatory wall and are subperiosteally located, usually in the upper temporal quadrants of the orbit. X ray shows pressure bone erosion.

Pathology The mass contains cholesterol crystals in addition to other structures found *in teratoid tumors.*

Treatment. Surgical removal as for dermoid In the Constans case there was no recurrence after surgical removal.

CYSTS OF ORBIT

(1 Case) Arising from the optic nerve under surface at the site where the nerve enters the sclera (Fig 444) these cysts are caused by faulty closure of the fetal cleft which allows a bulging of the retinal layer There is an associated microphthalmia (Reese)

The one case in this series was that of an eight months-old child with a microphthalmic eye and an associated mass behind the globe. The exophthalmus was slowly progressive. At operation the eye and the cystic mass behind the eye were removed by enucleation The specimen was bilobed the cyst was almost the size of a normal eye, with the small eye closely attached to its anterior surface

Differential Diagnosis. *Cysts of the orbit must be differentiated from*

(1) Encephaloceles or Meningoceles which can be reduced by sustained pressure on the orbital contents. This procedure may cause a *convulsion so it should be done with care*

NEUROFIBROMAS

(2 Cases) Occurring as a congenital peripheral nerve involvement as a central nerve involvement, and, intradurally in the nerves themselves, the tumors may appear anywhere in the body where there is nerve tissue and they range in size from very small lesions to the very extensive ones of the plexiform neuromas.

Neurofibromas are frequently associated with lid extensions (Fig 445A) and may lie in the muscle cone or anywhere in the orbit (Fig 445 B) Exophthalmus is slowly progressive though it may increase rapidly at puberty or during pregnancy Associated

abnormalities occur as café-au lait spots, skin tumors, and defects in the bones such as fossae in sides or roof of orbit or temporal bone irregularity of the shafts of long bones subperiosteal bone cysts and enlargement of optic foramen Occasionally there is found a pulsation of the globe transmitted through a defect in the orbital roof and synchronous with the radial pulse but without a bruit

be differentiated from

(1) Angiomas } discussed under *Angiomas*
(2) Dermoids } (Pg. 549)
(3) Gliomas of optic nerve which may have many of the associated congenital defects of neurofibroma and are thought by some to be closely related (Pg 557)
(4) Sarcomas, in which the growth is rapid and there are no associated congenital defects



A. Neurofibroma of orbit and lids.
B Neurofibroma of orbit

Fig 445

One of the two cases of neurofibromas was in a nine year-old girl who had a progressive axial exophthalmus of seven years duration The orbital contents were slightly compressible and the possible clinical diagnosis of an angioma was considered but cafe au lait spots on the buttocks and a defect in the temporal bone made the diagnosis of neurofibroma more likely This proved to be true and the tumor was surgically removed The second case had an extension into the lids and it was necessary to do several plastic procedures to get closure of the orbit

Differential Diagnosis. Neurofibromas must

Here bone is actually invaded and mobility and visual loss result early from invasion and pressure

Pathology Similar to neurofibromas in lids and elsewhere When the palisades of spindle cells are separated by collagen the formation is called a Verocay body and the tumor classified as a Schwannoma

Treatment. The tumors are not radio-sensitive Surgery depends on the size and extent of the tumor The tumors, though usually multiple are not malignant and conservative therapy in treating the local lesion is advisable Repeated operations may be necessary to control the slowly progressive growth

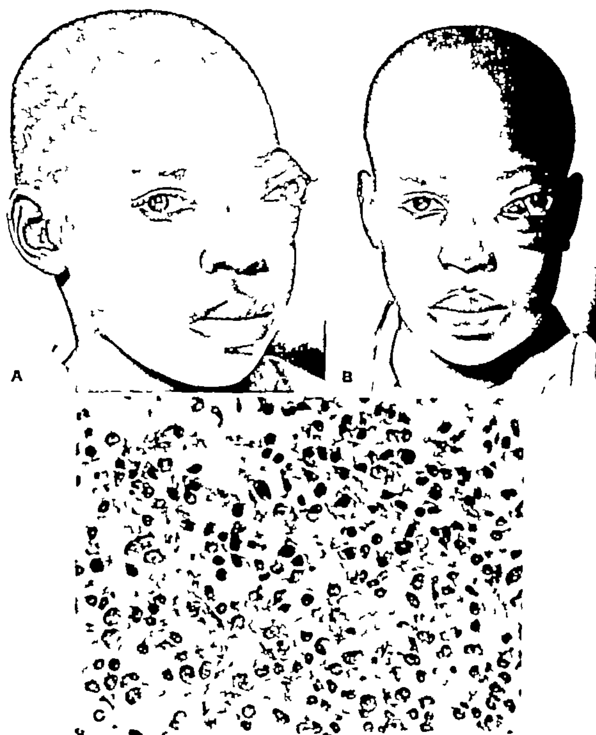


Fig 446

A and B Plasmacytoma—duration 2 years. C. Photomicrograph.

PLASMOCYTOMAS

(1 Case) Composed of plasma cells these tumors which occur in the orbit and, also as conjunctival tumors alone may well be a variant of the so-called pseudotumors. The case in this series was a ten year-old Negro boy who had a slowly developing proptosis of two years duration and a visible and palpable tumor at the nasal canthus which displaced the eye laterally. There were ten millimeters of exophthalmus. The mass was firm lobulated and

non tender There was enlargement of the regional lymph nodes (Fig 446 A–C)

Pathology The diagnosis was made on vital staining of the masses of plasma cells.

Treatment. This case was given x ray therapy and improvement occurred However, complete follow-up was not possible so that the ultimate outcome is questionable. It is generally felt that the plasmocytoma is a peculiar inflammatory response and on this theory might be considered as in the pseudotumor group The etiology is unknown and treatment nonspecific.

PSEUDOTUMORS

(18 Cases.) Pseudotumors of the orbit are the most common cause of unilateral exophthalmus in the adult (Reese and Day) They are inflammatory in origin and run a self limited course which is not influenced by therapy of any type (Fig 447 A–C)

Day found eighteen cases of pseudotumor in a review of one hundred twelve cases of unilateral exophthalmus in the Wilmer Institute 1937–1948 The youngest was nine years old the oldest sixty four with the majority of the patients in the fourth to sixth decade Two-thirds of the patients were women

The development of exophthalmus over the course of several weeks was accompanied by pain and inflammatory signs in one half of the cases A palpable mass of firm non-compressible nature was felt in 40 per cent of the cases. Depending on the site and extent of the tumor muscles were involved in two-thirds of the cases Vision was reduced in one third of the cases but field changes and intraocular changes were rare X ray showed only soft tissue mass

Biopsy of the mass for diagnostic purposes had no ill effects, but extensive orbital exploration or exploration by the intracranial route caused complications much worse than the process itself Return of vision with full function was usual Enophthalmus, as found by Reese in some cases, did not occur in Day's series but a residual low grade ptosis was common

Differential Diagnosis. Pseudotumors must be differentiated from

(1) *Sarcomas* which may have either a slow or rapid course are invasive They may cause muscle palsies, and bone erosion and invasion attended by late pain (Pg 559)

(2) *Mixed tumors* of lacrimal gland which are usually slow in growth, invasive, and unaccompanied by inflammatory reaction. (Pg 561)

(3) *Lymphomas and lymphosarcomas,* which may have associated lesions elsewhere and abnormal blood or bone marrow picture (Pg 570.)

(4) *Metastatic orbital tumors* which have a primary lesion elsewhere give inflammatory signs early pain and fixation of orbital tissues, very similar to those of pseudotumors (Pg 570)

(5) *Metastatic inflammatory lesions* which give history or signs of previous inflammatory process.

(6) *Intracranial meningiomas* which usually show a hyperostosis along greater wing of sphenoid. (Pg 558.)

Pathology The picture is varied from diffuse round-cell infiltration to a typical granuloma containing epithelioid cells, and giant cells with fibroblastic and endothelial activity Bacterial studies to date have been negative.

Treatment. None.

LIPOMAS

(2 Cases.) Benign slow-growing orbital tumors, these occasionally occur bilaterally and are seen in adults. They are compressible to some extent and usually lie in the anterior portion of the orbit. They are non invasive and do not cause pressure bone erosion

Differential Diagnosis Clinically diagnosis is suspected but it is usually made by biopsy

Pathology The tumors are composed of lobules of adult fat which are not encapsulated.

Treatment. Surgical excision is indicated since these tumors are not radio-sensitive

LIPOGRANULOMAS

Lipogranulomas present a variant of the above slow-growing benign unobtrusive tumor

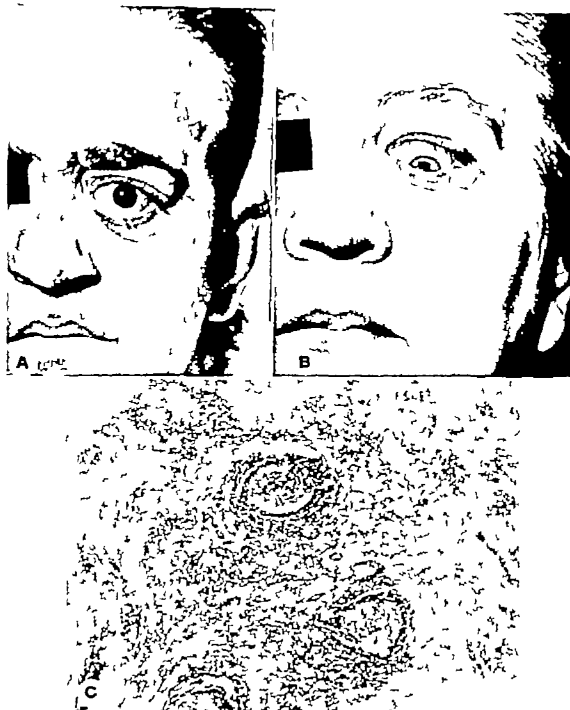


Fig 447

A. Pseudo tumor left orbit.
B Pseudo tumor left orbit showing early isolated levator involvement.
C Photomicrograph showing many germinal centers of lymphoid cells

A case report of a patient of Dr Rheim M Jones is instructive

This lipogranuloma was a rapidly enlarging tumor which caused definite pressure symptoms and demanded surgical intervention

A middle-aged white man in February 1948 developed a small mass in the right temporal region. As the mass gradually enlarged it was accompanied by painless protrusion of the right eye There was no disturbance of vision. When the tumor was surgically removed, it proved to be a lipogranuloma. Eight months later the mass recurred with pain and swelling of the

right lids and orbit. Vision was reduced to 20/50 papilloedema was present, and there was marked limitation of motion.

An orbital decompression was done to relieve the pressure on the globe. Postoperatively the pain subsided, and the oedema of the lids gradually decreased, but there was no light perception in the eye in spite of the apparently normal-appearing fundus. Some motion of the globe was returning at the time of this note.

Pathology The tissue removed at operation was primarily fat with a stroma infiltrated with lymphocytes plasma cells, and scattered giant cells

Comment The final outcome on this case is not known but it certainly followed an entirely different clinical course from that of the simple lipoma raising the question of whether it might not be one of the many variants of the pseudotumor group

FIBROMAS

(0 Cases.) Fibromas of the orbit are very rare Fowler and Terplan in a review of the literature found them to occur in the second or third decade The tumors occur anywhere in the orbit but are attached to the periosteum or to a tendon of the extraocular muscles Diagnosis is usually made on the pathological section Irradiation may retard the recurrence of the growth if it is not completely removed surgically

TUMORS OF THE OPTIC NERVE

GLIOMAS

(1 Case) Gliomas of the optic nerve occur in children and are noted usually in the first decade Females are affected about twice as frequently as males. The tumors are slow growing and produce early visual disturbances and a later axial exophthalmus The eye grounds may show papilloedema venous engorgement and wrinkling of retina with stria Visual fields may be narrowed or have bizarre contractions due to actual nerve invasion Optic atrophy occurs but late X rays show an enlargement of the optic foramen without any evidence of hyperostosis. Verhoeff describes the enlargement of the growth as a proliferation of pre-existing neuroglia and suggests glioma be classified as primary intraneural tumors This proliferation may extend as far forward as the disc and form a white cystic intraorbital mass. Multiple tumors may occur

Differential Diagnosis Gliomas must be differentiated from

(1) *Angiomas* of muscle cone which are compressible radio-sensitive and usually do not produce early visual disturbance or cause field defects. (Pg 549)

(2) *Meningiomas* which occur in adults. (Pg 558.)

(3) *Neurofibromas*, which present many associated defects some that are found in gliomas.

Pathology The tumor composed of neuroglia and the cell type may be the astrocyte or oligodendrocyte

Treatment. Incomplete removal of growth seems to stop the progress or at least slow down the enlargement The tumors are so slow-growing that Hudson and Lundberg felt partial removal was sufficient. Local recurrences, in their experience did not take place However there is possibly some question as to the validity of the impression that partial removal is sufficient

Broendstrup thinks a Krönlein approach offers a better chance of saving the eye and a craniotomy is not indicated even though the optic canal is dilated. Craniotomy is indicated if the other eye is involved and there are symptoms of an intracranial lesion The modified Krönlein approach gives excellent exposure and with the post-hairline incision leaves no deformity

Davis points out that multiple lesions occur with glioma of the optic nerve and that the syndrome is closely associated with von Recklinghausen's disease His plea for the orbital approach to these tumors is logical and is in accord with the ideas of Hudson and Broendstrup. The transfrontal route as advocated by Dandy in gliomas of the optic nerve brings an added operative hazard and can guarantee no greater percentage of success.

MENINGIOMAS

(3 Cases intraorbital, 12 Cases intracranial.) May be classed as psammomas, endotheliomas, fibromas, arachnoblastomas and extra-neural tumors of the optic nerve. They are found in adults, which is an important differential in considering optic nerve tumors. The incidence is higher in women than men. In this series *three meningiomas were confined to the orbit* alone and twelve had apparently an intra cranial source

The age incidence is usually in adults over thirty more frequently in the fifth decade. Early visual disturbances and muscle palsies precede exophthalmus. Eye grounds may show venous engorgement some wrinkling of the retina with striae due to actual pressure of the tumor in the muscle cone Field defects show a bizarre or concentric construction On X ray orbital meningioma may show enlargement of optic foramen and often hyperostoses

Meningiomas of the greater wing of the sphenoid are important diagnostically as of all intracranial tumors they most frequently produce exophthalmus. The exophthalmus is *the axial type with engorgement of vessels* papilloedema and oedema of the lid. Intra cranial meningiomas show characteristic hyper ostoses along the greater wing of the sphenoid.

Differential Diagnosis. Meningiomas of the orbit must be differentiated from

(1) Angiomas of the muscle cone which usually occur in children and are radiosensitive rarely cause enlargement of the optic foramen visual loss and field defects (Pg 549)

(2) Gliomas which occur most frequently in children (Pg 557)

(3) Neurofibromas which have associated congenital defects. (Pg 552.)

Intracranial Meningioma must be differentiated from

(1) *Osteomas* in the sphenoid region which usually occur before the age of thirty produce visual disturbances papilloedema and optic atrophy (Pg. 567)

(2) *Pseudotumors* which give rapid exoph thalmus with inflammatory signs and muscle palsies. (Pg 555)

Pathology The cells have large oval faintly staining nuclei lying in closely packed cell nests with little intercellular connective tissue They are not encapsulated and are locally invasive.

Prognosis. In the orbital meningioma the tumor growth is so slow that local removal seems at the time to be a cure, but most cases, if followed long enough show local recurrence.

Treatment. *The tumors are radio-resistant.* If the tumors are intracranial the handling of the case is in the field of the neurosurgeon

FIBROMATOSIS OF THE NERVE SHEATH

(0 Cases) This is described by Davis, in which dense connective tissue filled the orbit and was intimately fused with the dural sheath These tumors are extremely rare and little is known about them.

PRIMARY MALIGNANT TUMORS OF THE *ORBIT*

TERATOMAS

(0 Cases.) Extremely rare malignancies which contain structures derived from all the germ layers these tumors are present at birth and *their growth is very rapid. The eye on the side* with the tumor may be located at the apex of the mass and is often rudimentary

The case pictured (Fig 448 A and B) is by the courtesy of Doctors Young Fountain and Coleman It shows the size of the tumor in an infant at one month in age and again at eleven months when death occurred The growth consisted of a globular and vascular solid mass which protruded from the orbit and located on the anterior surface was the flattened atrophic eye

Differential Diagnosis. Teratomas must be differentiated from

(1) *Sarcomas* and other malignant tumors which usually occur at some time after birth

Pathology (Dr Young's case) The tumor was comprised *of heterogeneous tissue well-*differentiated and fairly well-organized central cortical elements, structures of skin cysts lined by columnar epithelium, bone cartilage and smooth muscle The eye exhibited the effects of compression but not of invasion

Treatment. Kirman reported a case in which exenteration of the orbit was done and the patient recovered

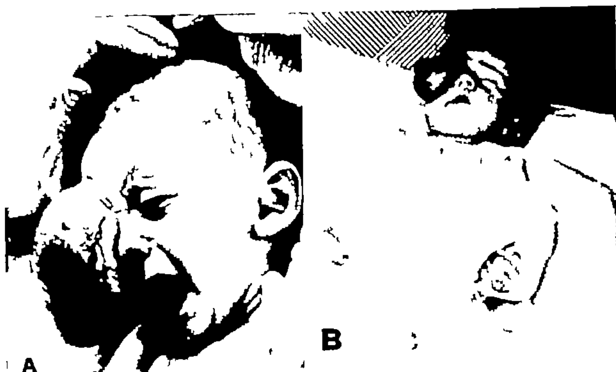


Fig 448

A. Teratoma of orbit, patient one month of age.
B Teratoma of orbit patient four months of age, shortly before death



Fig. 449

A Small round cell sarcoma—surgical removal of tumor followed by intensive irradiation therapy
B Small round cell carcinoma patient well.

SARCOMAS

(8 cases—4 children 4 adults.) Classified under the name of the predominating cell type in the tumors angio-, chondro- fibro- leio-myo- myo-, myxo- neuro-, osteo-, rhabdo- and small round cell

SMALL ROUND CELL SARCOMAS

These are most frequently met in children and constitute the four cases of this series (Fig

449 A) The ages of these four children ranged from two and one-half to seven years In all the course was rapid with death occurring in two to four months time Exophthalmus was the first sign and this, associated with oedema of the lids and fullness in the temporal fossa, rapidly increased Muscle palsies first indicated by diplopia appeared early and were followed shortly by marked limitation of motion As the invasion of the tumor progressed venous engorgement was common In the oldest child there was a decrease in vision to 20/70 (Enlargement of the regional lymph nodes was early) Pain occurred as a result of bone invasion

Even when a frozen-section biopsy indicated the type of tumor as in two of these children exenteration was not the primary procedure for the surgeon had failed to obtain consent of the parents. Perhaps exenteration would not have changed the outcome One case though which is not included in this series had prompt radical surgery followed by intensive irradiation and in a ten-year follow up there was no recurrence. (Wilmer records of 1936) (Fig 449 B)

RHABDOMYOSARCOMAS

These very malignant tumors are rarely found in the orbit In the reported literature all cases except one were in children One case of Reese s developed the tumor after irradiation for retinoblastoma and was considered the direct result of the irradiation. Most of the tumors occur in the upper inner quadrant of the orbit, their growth is rapid and death from metastasis usually occurs

ANGIOSARCOMAS

(2 Cases) Of relatively low grade malignancy these tumors more frequently occur in adults. They are extremely rare and puzzling to study One patient was a sixty-eight year old woman with an exophthalmus of four years duration which did not respond to adequate x ray therapy The orbital mass removed piecemeal and by suction showed a typical angiosarcoma There was no follow-up on this patient A second patient, in which the pathological diagnosis of angiosarcoma was based on one biopsy only, has been followed four years without further extension of the tumor

Carelli and Cangelosi reported a thirty month cure in a case of theirs where the tumor was surgically removed and the orbit given 1800 r at 140 K V 25 ma. with a 1.0 mm aluminum filter distance 50 cm. air

FIBROSARCOMAS

(1 Case.) These are tumors of rather slow growth yet of definite malignancy They are attached or in close proximity to the orbital wall and are frequently encapsulated. Extension is by local invasion and metastases are late

One patient a twenty two-year old white man developed a mass which was first noted in the left lower lid and extended as far as the lateral orbital wall. Biopsy showed it to be a fibrosarcoma that had originated in the periosteum The course was slowly invasive over four years time with death from cranial extension The tumor was not radio-sensitive In this case the primary surgical procedure had been conservative rather than radical.

MELANOMAS OF THE ORBIT

As primary tumors these are extremely rare and are usually an extension of choroidal melanomas

Differential Diagnosis. Sarcomas in children must be differentiated from

(1) *Neuroblastomas* of the suprarenal which metastasize (Pg 570)

(2) *Acute orbital cellulitis* which may be associated with sinus infection

(3) *Teratomas* which are usually present at birth (Pg 558.)

(4) *Lymphomas* including chloromas which have multiple tumors and general glandular enlargement. (Pg 570)

(5) *Benign congenital tumors* which have a slow course (See Primary Benign Orbital Tumors.)

Sarcomas in adults must be differentiated from

(1) *Mixed tumors* of the lacrimal glands

which are slow-growing invasive tumors. (Pg 561)

(2) *Pseudotumors* which produce a rapidly increasing exophthalmus with fixation of the orbital tissues (Pg 555)

(3) *Secondary orbital tumors* carcinomas, nasopharyngeal tumors and metastatic tumors.

(4) *Lymphomas* which have associated blood or bone marrow abnormalities. (Pg 570)

(5) *Benign congenital tumors* such as angiomas, dermoids or neurofibromas.

(6) *Generalized diseases* which may involve both orbits, malignant exophthalmus (post thyroidectomy)

Pathology Similar to sarcomas described previously In children sarcomas are usually the small round-cell type or rhabdomyosarcomas In adults the cell type may be one of any previously mentioned.

Treatment. Early radical surgery is indicated in children, as the course in all the sarcomas is an extremely severe one. The fact that patients are occasionally saved by this method keeps the picture from being one of utter despair Intensive irradiation should follow the surgery except in cases of rhabdomyosarcoma where irradiation is of little, or no value

In adults the course in most sarcomas is less rapid than in children but none the less grave Here also early radical surgery followed by irradiation is advised.

TUMORS OF THE LACRIMAL GLAND

MIXED TUMORS

(10 Cases.) Mixed tumors of the lacrimal glands are malignant, unilateral locally invasive and late in metastasizing Clinically exophthalmus is usually the first symptom though occasionally it is preceded by pain lacrimation or diplopia The globe shows a downward displacement and often an outward rotation Beneath the temporal supra-orbital ridge a soft mass can be palpated this varies in consistency depending on the amount of encapsulation With these tumors the course of growth may be very slow one patient in our series had a history of proptosis for nineteen years. Invasion locally is the rule, with late metastases occurring when there have been repeated operative procedures without complete removal Retinal folds, a local pressure phenomenon, and papilloedema with venous stasis occur with the invasion and fixation of the orbital tissues. Limited motility in the lateral and superior recti usually indicates local invasion of the muscle X ray often reveals erosion or invasion of the temporal orbital wall.

Of ten cases of mixed tumors of the lacrimal gland four were in Negroes six in whites four in women and six in men The patients ranged in age from twenty-six to sixty-three years, the average being in the fifth decade. Two could not be followed after operation and one was not operated until 1948 Of the remaining seven patients two have died

One a Negro woman, thirty nine years old, had a history of orbital pain and exophthalmus of one year's duration X rays at this time showed a soft orbital mass containing calcium deposits. A presumptive diagnosis of angioma was made and the orbit irradiated. When the size of the mass was not reduced surgery was advised, but the patient refused. She returned four years later and at that time had a proptosis of twelve millimeters vision was reduced to 10/200 and there was limited motion in the lateral and superior recti muscles At this time a Krönlein operation was done, the tumor was removed but the bone was replaced. Sections showed a mixed tumor of the lacrimal gland. A recurrence manifested itself in nine months time. On general physical examination, the patient was found to have a hard nodular enlargement of the thyroid gland believed clinically to be a carcinoma. The orbit was then exenterated and four weeks later a thyroidectomy was done The thyroid section showed an adenocarcinoma The relationship of the two tumors is interesting but which was primary could not be proven The patient lived four years longer but died from generalized metastases.

The second death was in a fifty-eight year old Negro man with a history of a tumor

had been removed from the lower lid ten years before. He had had a low grade proptosis for a number of years When first seen the orbit was completely invaded with tumor tissue (Fig 450 A and B) and it was difficult to tell its exact origin X ray showed that the tumor had extended into the sinuses and an exenteration was done Histologically it was a typical mixed





Fig 450

A. Mixed tumor of the lacrimal gland
B Showing invasion of sinuses—x-ray reversed

tumor and the patient died in three years time from an intracranial extension

Five patients lived nine years, five years four years, three years and one year respectively Operative procedures in the ten patients consisted of Krönlein on two with a recurrence of the tumor in one brow incisions were made on six patients and lateral canthotomy with conjunctival incisions in two. Exenterations were necessary for two patients one of whom had developed a recurrence following previous surgery

In summary five continued well two were dead The outcome in two was unknown and in one the follow up was too short to be significant Sanders reported twelve cases in which three had obtained a satisfactory result five were dead, and four were living with recurrences. Benedict reported thirteen cases, in addition to those of his series in 1930 of which five were dead and eight living but two of the living were having recurrences.

Differential Diagnosis. Mixed tumors of the lacrimal gland must be differentiated from

(1) *Sarcoid nodules* of orbits which are usually bilateral and are accompanied by other manifestations of sarcoid (See Sarcoid under Lid Tumors)

(2) *Dermoids* which occur usually in younger persons X rays may show a clear-cut punched-out defect of the medial plate of bone without bone invasion or limitation of motion. (Pg 551)

(3) *Angiomas* which are radio-sensitive compressible tumors, frequently accompanied by dilated vessels in anterior adnexa. (Pg 549)

(4) *Periostitis* which is on the basis of syphilis, causes night pain and has a more acute onset Here serology is positive

(5) *Pseudotumors* which also have a more acute onset accompanied by inflammatory signs.

(6) *Acute dacryoadenitis* which has an acute onset with mumps

Pathology Mixed tumors of the lacrimal glands are similar to mixed tumors of the salivary glands They are often encapsulated The cells may be of the epithelial type or of the connective tissue series with marked variation in different areas of the tumor Cords of anastomosing cells give a picture of a cylindroma cells in sheets or in pearl formation suggest a carcinoma connective tissue varying in one area from cartilage deposit to myxomatous masses in another, resembles the sarcomas

Treatment. The tumors are not radio-sensitive and therefore the best prognosis is on the basis of early and complete radical surgical removal. If the tumor mass is encapsulated and there is no limitation of motion or evidence of orbital extension a modified Krönlein approach gives the best exposure It is important that the bony lateral wall of the orbit should not be replaced, since X ray evidence of orbital extension has been absent in a number of cases where operation has revealed actual tumor extension into the lateral wall. The modified Krönlein approach using a post hairline incision gives an adequate exposure with the opportunity for making extensive eradication of the tumor without harm to normal structures The fact that the lateral wall of the orbit is not replaced produces no cosmetic defect

Recurrences in the reported literature are many and are on the basis of inadequate primary surgical removal. Benedict using a brow incision to shell out the tumor obtained good results with his technique However the modified Krönlein approach gives better exposure and permits the permanent removal of the lateral orbital wall, thus cutting down the possibility of residual tumor in the bone. If there has been involvement of the orbital tissues as demonstrated by an actual limitation of motion by extensive X-ray soft tissue or bone changes, or by loss of vision papilloedema or retinal folds exenteration should be done as a primary procedure (See operative technique under Conjunctival Melanomas Pg 530) Unless specifically involved the lids need not be removed at the time of exenteration. Should bone destruction then be found in the lateral wall there should be a wide bone removal. When bone or sinuses have actually been invaded or when recurrences take place prognosis is poor for surgical removal then rarely proves adequate Sanders reports one case that was adequately controlled by X ray therapy but the dosage is not given The advantage of an initially radical procedure in mixed tumors of the lacrimal glands cannot be overemphasized.

Operative Technique *Modified Krönlein Operation* General anesthesia is required.

The original Krönlein operation called for a skin incision over the lateral orbit rim which resulted in a very deforming scar The modified approach with the skin incision placed one centimeter behind the temporal hairline causes no cosmetic defect thus the operation becomes much more useful in the removal of orbital tumors and in giving a lateral decompression of the orbit in malignant exophthalmus

The skin over the temporal and lateral frontal region is shaved to 3 cm. behind the hairline A curved skin incision is made, with a small Bard Parker scalpel one centimeter behind the hairline This extends from a point level with the top of the tragus to a point on the forehead in line with a perpendicular dropped through the lateral canthus. Since large vessels lie just beneath the skin great care should be used in making both the initial incision and the blunt dissection of the skin flap to the orbital rim. Small bleeders are best controlled by cautery The undermining of the skin flap to give adequate exposure is the most tedious part of the operation The periosteum along the lateral orbital rim is incised with a scalpel and stripped from both sides of the orbital wall with a small periosteal elevator A scissors incision directed backward and downward to split the temporal muscle fibers and fascia greatly enlarges the exposure with a minimum of bleeding and of postoperative reaction

The Stryker orthopedic bone saw which

TABLE 36—Summary

Differential Diagnosis Primary Orbital Tumors

Tumor	Age of Patient	Rate of Growth of Tumor	Location	Palpation	Auscultation	X-Ray	Abnormalities of Vision Fields Mobility	Treatment
Angioma, benign	Usually congenital at birth or early childhood or occasionally at puberty or later adult life	Slow usually self limited	1. Upper nasal quadrant of orbit 2. Anywhere in orbit including muscle cone	Compressible	Very rarely bruit	Soft tissue mass pressure regular bone atrophy Foam of bone. Diagnostic response to X-ray therapy	Rare	1. Irradiation 2. Surgery
Teratoid tumors Dermoid, benign	Early childhood congenital	Slow	1. Upper temporal quadrant	When cystic, may be fluctuant		Mass may contain calcium Smooth pressure atrophy of bone not radiosensitive	Rare	Surgery
Cyst, benign	Early childhood	Slow	Behind eye	Cystic			Associated with microophthalmia	Surgical removal
Neurofibroma, benign	Congenital early childhood	Slow	Frequently associated with involvement of lids	Lids here involved, bag of worms	No bruit but may have pulsation	Foamal orbital bones, and temporal bones Bone cysts irregularity of shaft of long bones Enlargement of optic foramen	May have involvement of limbus and varied muscle palsies. Late get papilledema and venous congestion	Surgery
Pseudo-tumor benign	Adults 4 to 6 decade	Rapid with pain and inflammation. Signs one-half cases	Diffuse involvement of any or all of orbital tissues	Orbital contents fixed, not compressible	No bruit	Only soft tissue mass	Vision reduced in two-third cases. Rare field or intraocular changes	None
Lipoma, benign	Adults usually	Slow growing	Any location, but usually anteriorly	Somewhat compressible	No bruit	Soft tumor mass	None	Surgical removal
Glioma, benign	Found in children, females more frequently than males	Slow axial exophthalmos	Involves the optic nerve	Axial non-compressible exophthalmos		Enlargement of optic foramen without hyperostosis	Visual disturbance usually early Field defects occur Papilledema Venous engorgement	Surgical removal

TABLE 36—CONTINUED

TUMOR	AGE OF PATIENT	RATE OF GROWTH OF TUMOR	LOCATION	PALPATION	AUSCULTATION	X-RAY	ABNORMALITIES OF VISION FIELDS MOBILITY	TREATMENT
Meningioma	In adults usually	Slow usually axial exophthalmus	Orbit t nerve or intracranially with anterior extension	Orbital content not compressible	No pulsation or bruit	Hyperostosis along sphenoid ridge or optic foramen	Get visual disturbances. Muscle palsies early. Venous engorgement. Bizarre field defects. Papilloedema	Neurosurgical
Teratoma malignant	Congenital usually noted at birth	Rapid enlargement	Involves whole orbit and rapidly pushes out orbital contents	Firm with cystic areas		Contains bone and cartilage. Pressure changes in orbital walls	Atrophic or malformed eye	Surgery exenteration
Sarcoma malignant	Any age in young more malignant	Rapid	Anywhere in orbit	Hard noncompressible invasive bone eroded	No bruit	Bone invaded with moth-eaten appearance or bone loss	Visual loss. Motility changes. Eye fixed from muscle invasion	Radical surgery and irradiation postoperatively
Mixed tumor of lacrimal gland malignant	Usually adults	Slow growing	Lacrimal gland	Can be felt beneath brow. Firmly fixed		May invade bone	Late muscle palsies. Pressure symptoms	Surgical removal

be autoclaved makes possible the cutting of the heavy orbital rim with minimal trauma. The oscillating blade can be set at any angle and since it cuts bone only and will not cut the soft orbital tissue or the surgeon's fingers a more accurate cut can be made. Bone edges can be trimmed and beveled above and below to blend in with the superior and inferior orbital rim. A stream of saline should be played on the saw as it cuts to avoid burning the bone.

The cut above and below is made through the dense bone of the orbital rim as far as the thin lateral plate. This piece can then be easily broken out with a pair of bone pick ups and the thin temporal plate removed by small rongeurs as far back as the apex of the orbit.

The removal of the lateral wall gives excellent visual exposure of the lateral orbital contents and gentle digital examination of the whole orbit can be made without damage.

Tumors of the lacrimal gland can thus be removed under direct vision which is most important. Equally important is the fact that no cosmetic defect occurs, if the bony orbital rim and lateral wall are not replaced. For these tumors of the lacrimal gland where bone invasion is common or in malignant exophthalmus the bone should not be replaced. When the periosteum is left new bone is laid down, so it is important to excise the periosteum also.

In closure it is not necessary to suture the cut of the temporalis muscle as the fibers have merely been split and readily fall together again. The skin is closed by small interrupted dermalon sutures and a small wick drain is brought out about the lower mid-portion of the incision. The eye and wound are dressed with vaseline gauze and an elastic pressure banc is used over the eye for two days. At th

dressing on the second day the drain can be removed and the sutures in six or seven days



Fig. 451 Aneurysm—orbital

of the lacrimal glands have all been reported but they are rare curiosities in a field where the mixed tumor is prominent

SECONDARY TUMOR OF THE ORBIT

ARTERIOVENOUS ANEURYSMS

(3 Cases.) These tumors of the orbit and cavernous sinuses may be congenital or may follow trauma The congenital type often does not make its appearance until the third or fourth decade, and is differentiated from the traumatic type only by the history of injury

The typical picture is of a rapidly developing unilateral exophthalmus with a noise in the head synchronous with heart beat There is usually a definite pulsation of the orbita contents and a bruit can be heard over the eye and head Vessels of the forehead lids and conjunctiva become dilated and intraocular venous engorgement occurs (Fig 451) There may be various degrees of muscle palsies and as a late sequella a secondary glaucoma may develop The aneurysm tends to increase in





Fig 452

A. Carotid cavernous aneurysm
B Carotid cavernous aneurysm (lateral view)

A late traumatic enophthalmos is occasionally seen following the removal of orbital tumors.

Other Tumors of the Lacrimal Gland

Sarcomas (Alger) Angiomas (Pantry) Lymphomas (Francis) and Fibromas (Klempler)

size Arteriograms may be helpful in early diagnosis (Fig 452 A and B)

Differential Diagnosis. Aneurysms must be differentiated from

(1) *Angiomas* which develop more slowly and are usually seen in the younger age group

(2) *Neurofibromas* which appear in the younger age group are slow in growth and have associated congenital defects.

Pathology It is often difficult to differentiate the aneurysm from angiomas since both show dilated, endothelial lined blood spaces.

Treatment.

Neurosurgical—(1) Ligation of carotid
(2) Ligation of ophthalmic artery

Intermittent Exophthalmus was proven by Walsh and Dandy to be the result of an arteriovenous aneurysm in their patient Not all such cases are so explained Their patient could produce an exophthalmus by lowering the head, coughing, holding the breath or by forced expiration or pressure on the jugular veins. At operation a large arteriovenous aneurysm was found to fill the floor of the middle fossa and to extend into the anterior fossa. The mass was destroyed with electrocautery Postoperatively the patient was completely relieved of the intermittent exophthalmus (Fig 453)

OSTEOMAS

(4 Cases) These benign tumors usually originate in the accessory sinuses and early in growth invade the orbit. The tumor usually occurs in adults and with slightly greater frequency in males The order of occurrence is in the frontal ethmoid maxillary and sphenoid sinus (Malan) Early ocular involvement is more common when the ethmoids or sphenoids are involved

Orbital extensions produce a slowly increasing exophthalmus which in one case of this series pushed the eye from the socket This resulted in a corneal ulcer and panophthalmitis that caused the patient to come to the clinic. Two osteomas of this series originated in the frontals and one in the ethmoids (Fig 454)

Sphenoidal osteomas produce visual disturbances, papilloedema and optic atrophy

Diagnosis is based on X-ray evidence of a circumscribed bony tumor originating in the sinus. Dandy notes that age is an important differential point in considering osteomas and meningiomas of the sphenoid region. Osteomas usually occur before the age of thirty and dural endotheliomas after thirty

Differential Diagnosis. Osteomas must be differentiated from *Meningiomas* in the region of the sphenoid, which occur usually after the age of thirty (Pg 558)



Fig. 453 Intermittent exophthalmus (case of Walsh and Dandy)

Pathology The tumor is covered with a periosteum and may consist of a solid bone with or without Haversian canals. It may be spongy in character with many fibroblasts and areas of new bone formation

Treatment. Some osteomas lie dormant for years and treatment is not indicated Surgical removal of enlarging osteomas of the ethmoids and the frontals lies in the field of the otolaryngologist, and surgery of the sphenoidal osteomas, in the hands of the neurosurgeon

X ray therapy may be tried to retard the growth of the spongiose osteomas.

CARCINOMA OF THE SINUSES

(9 Cases) This occurs most often in adult life around the sixth decade, although Godtfredsen reported one in a child of three years. (See Chap XIII) This tumor is very important to the ophthalmologist, for it usually pro-

duces exophthalmus as the earliest symptom The lid fissure is often obliquely slanted because of the nature and the location of the frequent and stasis with palpebral oedema and conjunctival chemosis is usually present (Fig 455)





Fig 454
A Osteoma of ethmoids.
B X ray showing osteoma.



Fig 455 Carcinoma of antrum. First symptoms were pain in orbital region then oedema of the lids and proptosis

tumor It is also singular in that one of its early symptoms is pain in the maxillary area and over the distribution of the second branch of the trigeminal The antrum ethmoids, frontals then sphenoids are the order of frequency in involvement

Exophthalmus is usually lateral rather than axial depending upon the location of the tumor Muscle palsies and visual disturbances are

Metastases to the cervical glands are reported in from one-fourth to one-third of the cases (Ahngreen-Ringertz)

X ray diagnosis is of great importance showing cloudiness of the sinuses with various degrees of destruction of the orbit

Differential Diagnosis. *Carcinomas of sinuses must be differentiated from*

(1) *Pseudotumors* which usually produce exophthalmus earlier in their course associated with early muscle palsies. (Pg 555)

(2) *Nasopharyngeal tumors* which cause early involvement of the fifth sixth and third nerves

(3) *Metastatic tumors* which have early associated inflammatory signs. (Pg 570)

(4) *Tumors of Lacrimal Sac* (Fig 456)

Pathology and **Treatment** of carcinomas of the sinuses are discussed elsewhere in this volume

NASOPHARYNGEAL TUMORS

(1 Case.) These tumors are not uncommon and are especially important to the ophthal

mologist for eye signs appear early (See Chap. XII) Only one case was found in the Wilmer records in the last ten years as these cases are referred directly to the Department of Otolaryngology Van Metre collected forty-six such tumors from the Johns Hopkins Hospital records 1925–1946 The ages of patients ranged from two to seventy years with the majority in the fifth or sixth decades. Thirty were males. The primary site of the tumor was the posterior wall of the nasopharynx in the region of the pharyngeal tonsil or in the fossa of Rosenmüller As the tumor advanced



Fig 456. Papilloma of the lacrimal sac—to be differentiated from tumors of ethmoids and dacryocystitis.

through the foramen lacerum early pain was produced in the orbit from the involvement of the second branch of the fifth nerve, followed shortly by a sixth then a third nerve palsy

Nasal symptoms and metastatic cervical gland involvement occurred either at the same time or after the eye symptoms

Godtfredsen in his series of four hundred and fifty-four cases found exophthalmus in only 4.2 per cent and there it occurred late. More frequent in the younger patients, it was associated with cervical metastases and was of the axial type with varying degrees of venous stasis.

The case in this series was a Negro boy of twelve years who first developed enlargement of the cervical nodes, then pain in the face and orbit (Fig 457) These were followed shortly by a *sixth nerve palsy* then complete ophthalmoplegia, proptosis and blindness. Biopsy of cervical nodes showed the tumor to be a carcinoma, and only then was the nasopharyngeal origin discovered

X ray caused a reduction of the proptosis in six weeks' time and a return of vision sufficient for counting fingers. Further follow up here was impossible.



Fig. 457 Nasopharyngeal tumor first symptoms, cervical node enlargement, pain in the face, proptosis, and muscle palsies.

Differential Diagnosis. Nasopharyngeal tumors must be differentiated from

(1) Carcinomas of the sinuses, which have lateral exophthalmus together with early pain over the second branch of the fifth nerve X ray reveals the mass in the sinuses (Pg 567)

(2) Pseudotumors which give earlier exophthalmus associated with inflammatory signs. (Pg 555)

(3) Metastatic tumors which produce early exophthalmus pain and inflammatory signs. (Pg 570)

Pathology and Treatment of nasopharyngeal tumors are discussed elsewhere in (Chap. XII)

METASTATIC TUMORS OF THE ORBIT

Metastatic Tumors

(2 Cases.) Metastasis to the orbit may result from almost all other primary tumors The most common in the adult is from tumors of the breast (Fig 458) and in children from the suprarenal. The left orbit is affected somewhat more frequently than the right because of its more direct blood supply Metastatic orbital lesions grow more rapidly than the primary lesions producing early pain and a pseudo-



Fig. 458. Metastases of carcinoma of breast to right orbit and choroid

inflammatory reaction with muscle palsies and reduced vision Treatment is palliative and is governed by the type and extent of the primary lesion

The importance of metastatic orbital tumors lies in the differential diagnosis from primary orbital tumors

NEUROBLASTOMA OF THE SUPRARENAL

(1 Case.) This is a tumor which frequently *metastasizes to the orbit* and the bones of the skull (Fig 458) The tumors are usually encountered in children under two years of age Frequently the first sign is ecchymosis of the lids and exophthalmus the metastases are widespread and death comes rapidly

Hutchinson described the suprarenal tumor with its typical early metastases to the orbit and skull. Pepper described a type which metastasized first to the liver and the mesenteric nodes, then to the orbit

Pathology The tumor is a firm pink tissue. *The cells* are slightly basophilic with large hyperchromatic nuclei in scant cytoplasm They are grouped in a pseudo-rosette formation and calcification may be present

Treatment. None



Fig 459 Neuroblastoma metastases to left orbit and right submaxillary nodes.

TUMORS OF THE ORBIT ASSOCIATED WITH GENERAL DISEASE

LYMPHOMAS

(1 Case.) *Lymphomas of the orbit are related* to the large group of lymphoid diseases which range from benign hyperplasia, to extremely malignant lymphosarcomas. The type and growth of the tumor mass is described under the section on the lids so it will not be dealt with here General differential diagnosis depends on the blood picture bone marrow changes general glandular enlargement and associated tumors Specific cell type indicates the subclassification but of more importance

is the invasive quality of the tumor and the rate of growth indicated by the mitotic count. In general, irradiation causes marked improvement, eradicating the lesions completely in the benign forms, and markedly slowing the course in the malignant forms. Surgery is of importance only in taking a biopsy to establish the type of cell and the invasiveness of the tumor

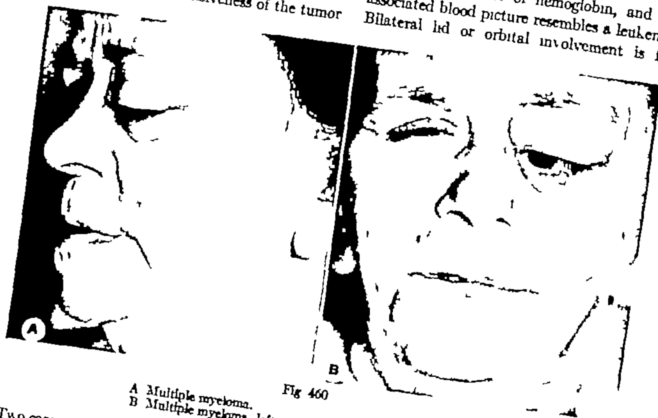


Fig 460

A Multiple myeloma.
B Multiple myeloma left eye pushed down by tumor mass.

Two cases recently seen gave the history of a chronic type of upper respiratory infection which had been diagnosed by the family physician as due to adenoidal overgrowth. The patients complained of the feeling of a thickness in the nasopharynx. In both cases firm, vascular masses the size of a large lima bean developed rapidly over the course of six weeks time In one the mass was found to be associated with an orbital extension and no other lymphoid lesions could be demonstrated Biopsy showed a very invasive and active lymphosarcoma In the other masses were found bilaterally in the lids (see Tumors of the Lids) and also a general glandular mediastinal and mesenteric enlargement

In both intensive irradiation therapy was instituted (See Lymphomas of Lids and Conjunctiva Pg 530)

CHLOROMAS

Green tumors, these occur in boys more frequently than girls and in most cases before the age of fifteen (Egerton) The etiology of the pigment is obscure but it is thought to be a breakdown product of hemoglobin, and the associated blood picture resembles a leukemia. Bilateral lid or orbital involvement is frequently the first symptom with associated involvement of the bones of the face and skull Symptoms are legion, depending on the structures involved Toxic manifestations with fever and emaciation produce a steady downward course, which ends in death.

MULTIPLE MYELOMAS

These tumors although closely related to chloromas occur in adults not children and they have a predilection for the orbit, sinuses ribs and vertex of the skull (Fig 460 A and B) Orbital involvement is usually bilateral and exophthalmus may become extreme as the orbit is filled by the tumor Visual loss, field defects, and fundal lesions are the result of pressure

Bence Jones proteins in the urine are diagnostic. A generalized bone rarefaction

specific areas of bone destruction is found in x rays and the bone marrow shows a characteristic picture The course is progressively downhill and *terminates in death*

TABLE 17—SUMMARY

DIFFERENTIAL DIAGNOSIS SECONDARY ORBITAL TUMORS

	AGE OF PATIENT	TYPE OF GROWTH OF TUMOR	LOCATION	PALPATION	CIRCULATION	X-RAY	ABNORMALITIES OF VISION FIELDS MOBILITY	TREATMENT
Arteriovenous aneurysm	*3rd or 4th decade or from trauma*	*Relatively rapid*	*Orbit and lids*	Corded somewhat compressible	Bruit present and ocular pulsation	May demonstrate AV communication with thorotrast	May have muscle palsies and reduced vision	Neurosurgical
Carcinoma of sinuses	Adults usually	Relatively early exophthalmos with lateral displacement	In order of frequency Antrum Ethmoid Frontals Sphenoids	Oedema of lid and conjunctival chemosis		Mass in sinuses. Varying degrees of orbital destruction	Frequent muscle palsies and visual disturbances	Surgery and Irradiation (See Chap. XIII)
Nasopharyngeal tumors	Usually adult but may occur in children	Late exophthalmos with involvement of cervical glands. Axial type	Nasopharynx Fossa of Rosenmuller Enters orbit through foramen lacerum				Earliest symptom of pain in 2nd branch of V paralysis of VI and III	Irradiation and surgery by Otolaryngologist. (See Chap. XII)
Lymphoma group including lymphosarcoma	Children rapid course Adults (usually rapid course)	Rapid enlargement of tumor masses	Generalized glandular enlargement with abnormal blood picture bone marrow etc	Mass firm usually movable Vascular		Generalized	May have muscle palsies	Irradiation
Metastatic tumors	*Children—as neuroepithelioma of adrenal adults, from breast* uterus, stomach bladder *etc*	*Rapid growth*	*Usually to left orbit*	*Hard, associated with pain and signs of pseudo-inflammatory process*		*May show invasion of bone*	*Muscle palsies and visual decrease early*	*Palliative* Irradiation or surgery
Malignant exophthalmos Post thyroidectomy	Adult	Steadily progressive	Usually bilateral but may be unilateral	Non-compressible			Muscle invasion and reduced vision from pressure	Surgical lateral orbital decompression

SCHÜLLER-CHRISTIAN DISEASE

This syndrome is marked by exophthalmus defects in the flat bones diabetes insipidus and a peculiar lipoid deposit in the tissues and bones. There is no age or sex specificity

Exophthalmus is usually unilateral, and defects in the orbital roof may cause pulsation of the proptosed globe Associated symptoms depend on the organs involved in the disease The course may be a slow downhill one or may be interrupted by remissions

Pathology The presence of the characteristic foam cell, accompanied by collections of lymphocytes, eosinophiles and plasma cells is necessary in making the diagnosis

Treatment is symptomatic

MALIGNANT EXOPHTHALMUS

This syndrome occurs postthyroidectomy in some cases. Usually exophthalmus is bilateral but it may be unilateral (Fig 461A) Steady progressive exophthalmus occurs with muscle palsies, oedema of lids, marked chemosis of the conjunctiva and pressure changes, which may

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Fig. 461

A. Malignant exophthalmos.
B Malignant exophthalmos after lateral orbital decompression. Incision post-hairline

result in the loss of the eyes. The exophthalmus is not compressible. When visual loss or ocular damage is threatened a lateral orbital decompression should be done The modified Krönlein operation with post hairline incision as previously described (See Mixed Tumors of the Lacrimal Gland Pg 563) gives excellent results. It is important that the whole lateral wall of the orbit be removed and the periosteum excised (Fig 461 B)

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Bony tumors have also been described in the tympanic cavity but are probably in most instances hyperostoses due to chronic suppuration and not real tumors Actual exostoses have been found in the porus acusticus

Adenoma. Verified adenomas have been seen at the entrance of the external meatus They are of about pea-size and consist entirely of glandular structure except for thin septa of connective tissue It is questionable that adenomas occur also in the tympanic cavity

Hemangioma. The ear is the most favoured location of the cutaneous angiomata of the head The angiomata occur as teleangiectasis or angioma simplex, often in the form of naevus vasculosus and as angioma cavernosum They might show very rapid growth and extend over the whole pinna, the external auditory canal and the tympanic membrane Primary angioma of the tympanic membrane, however, has not been seen with certainty

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Lymphangioma. Lymphangioma of the ear develops usually in later life but has also been observed at birth It is either circumscribed and might reach considerable size or involves the pinna more diffusely The tumor is either wrinkled or smooth has a steel-gray color and a spongy consistency The microscopic picture is identical with that of lymphangioma of other regions. Lymphangiectasis has also been found in the tympanic cavity and the mastoid process

Atheroma. Atheromas of the ear are not infrequent They are located usually over the posterior part of the pinna and the lobulus but have also been seen over the anterior part of the pinna and in the external meatus. Their growth is slow but can reach considerable proportions. Inflammatory changes are not rare

Dermoid. Dermoid cysts of the ear are usually located behind the pinna in the upper part of the mastoid process directly under the skin and over the periosteum They are round, elastic tumors with the characteristic structure of dermoids Verified cases have also been found inside the mastoid process.

Myoma. Myoma of the ear is very rare and shows the same characteristics as the myoma of other regions.

Myxoma. Also true myxoma of the ear is very rare. The tumor is transparent, of slight yellowish color and contains mucin Polypoid growths of inflammatory origin might be mistaken for myxoma Histologically, the tumor consists of well developed star-shaped cells with intercellular substance, rich in mucin Although treatment is surgical excision a wide margin of safety is required because of the tendency of myxoma to recur

KELOID

Keloid is not considered a true tumor It is usually found over the ear lobe and the retroauricular region The appearance is characteristic, as evidenced by elevated scar with increased vascularization and the great tendency to recur The keloid of the ear lobe often forms round tumors, at times of considerable size and may present some difficulty in diagnosis. Surgical removal followed by x ray or radium treatment, is required in larger lesions Small keloid masses will clear up with radium or x ray treatment alone (see Chapt III)

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Fibromas are found more often in the lobulus as a round hard tumor with smooth surface usually more prominent over the posterior surface. In this location they occasionally may reach considerable size In very rare cases fibromata have also been seen in the external auditory canal. Some of the fibrous tumors of the middle ear reported in the older literature are probably inflammatory polyps and do not belong in this group Fibromas have a tendency to recur after removal.

Papilloma. Papillomas are uncommon in the ear Several cases have been reported in the external auditory canal, but only very few over the pinna and the lobulus They are attached to the underlying structure either with broad base or slender stem have the shape of a cauliflower or thorn-apple and are of about cherry size and firm. Microscopically they consist of connective tissue that is diffusely branched and covered with thickened epidermis To this group probably also belong cornified excrescences that have been seen over the helix and the tympanic membrane and described under the name of cornu cutaneum. They consist of an outgrowth of the horny layer of the epidermis resembling the shape of a horn The surface usually shows parallel lines and is of dark brown color Papillomas have a tendency to recur after removal therefore a wide margin is given at the first operation

Lipoma. Lipoma is one of the rarest tumors of the ear and may occur in the external canal as well as over the pinna. They have the typical appearance of the lipoma found in other areas. Gruber reported a case of lipoma of the pinna that penetrated the cartilage but this case has not been verified microscopically

Chondroma. Proven cases of chondroma are apparently very rare They occur over the pinna and in the external auditory canal, have a broad base and are round and hard However also thorn or club-like chondromata have been reported The skin over the tumor is movable.

Osteoma. Osteomata are found in two different forms in the ear region The first group consists of fairly large, round tumors deeply embedded in the structure of the mastoid process or the squama and extend beyond its surface They are rare usually single relatively large and consist of compact bone The second group comprises small tumors located over the os tympanicum These tumors are commonly referred to as exostoses of the external auditory canal and are rather common They form super

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Papilloma. Papillomas are uncommon in the ear Several cases have been reported in the external auditory canal but only very few over the pinna and the lobulus They are attached to the underlying structure either with broad base or slender stem have the shape of a cauliflower or thorn-apple and are of about cherry size and firm. Microscopically they consist of connective tissue that is diffusely branched and covered with thickened epidermis. To this group probably also belong cornified excrescences that have been seen over the helix and the tympanic membrane and described under the name of cornu cutaneum. They consist of an outgrowth of the horny layer of the epidermis, resembling the shape of a horn The surface usually shows parallel lines and is of dark brown color Papillomas have a tendency to recur after removal therefore a wide margin is given at the first operation

Lipoma. Lipoma is one of the rarest tumors of the ear and may occur in the external canal as well as over the pinna They have the typical appearance of the lipoma found in other areas. Gruber reported a case of lipoma of the pinna that penetrated the cartilage but this case has not been verified microscopically

Chondroma. Proven cases of chondroma are apparently very rare They occur over the pinna and in the external auditory canal have a broad base and are round and hard However also thorn or club-like chondromata have been reported. The skin over the tumor is movable.

Osteoma. Osteomata are found in two different forms in the ear region The first group consists of fairly large round tumors deeply embedded in the structure of the mastoid process or the squama and extend beyond its surface They are rare usually single relatively large and consist of compact bone The second group comprises small tumors located over the os tympanicum These tumors are commonly referred to as exostoses of the external auditory canal and are rather common. They form super

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fically located small round structures either with broad base and indistinct margin or with a fine stem Not infrequently, these neoplasms are multiple and found in both external auditory canals Their structure is either compact or spongy bone at times rich in vascular canals. These growths have to be distinguished from the hyperostosis of the external auditory canal which is a hyperplasia and is not a true new growth

Bony tumors have also been described in the tympanic cavity but are probably in most instances hyperostoses due to chronic suppuration and not real tumors. Actual exostoses have been found in the porus acusticus.

Adenoma. Verified adenomas have been seen at the entrance of the external meatus. They are of about pea-size and consist entirely of glandular structure except for thin septa of connective tissue It is questionable that adenomas occur also in the tympanic cavity

Hemangioma. The ear is the most favoured location of the cutaneous angiomata of the head The angiomata occur as teleangiectasis or angioma simplex often in the form of naevus vasculosus and as angioma cavernosum. They might show very rapid growth and extend over the whole pinna, the external auditory canal and the tympanic membrane Primary angioma of the tympanic membrane however has not been seen with certainty

The cavernous angioma of the pinna is seen more frequently than the teleangiectasis and is usually single Also the external auditory canal might be the original site of the tumor At times the cavernoma will originate in neighboring structures and involve the ear secondarily For treatment see Chapt III

Cavernoma of the middle ear cavity and in the mastoid process has been observed They must not be confused with vascularized inflammatory polyps. Voss reported an angioma that engulfed the facial and the acoustic nerve seen at autopsy of an infant

Lymphangioma. Lymphangioma of the ear develops usually in later life but has also been observed at birth It is either circumscribed and might reach considerable size or involves the pinna more diffusely The tumor is either wrinkled or smooth has a steel-gray color and a spongy consistency The microscopic picture is identical with that of lymphangioma of other regions Lymphangiectasis has also been found in the tympanic cavity and the mastoid process.

Atheroma. Atheromas of the ear are not infrequent. They are located usually over the posterior part of the pinna and the lobulus but have also been seen over the anterior part of the pinna and in the external meatus. Their growth is slow but can reach considerable proportions Inflammatory changes are not rare

Dermoid Dermoid cysts of the ear are usually located behind the pinna in the upper part of the mastoid process directly under the skin and over the periosteum They are round, elastic tumors with the characteristic structure of dermoids. Verified cases have also been found inside the mastoid process.

Myoma. Myoma of the ear is very rare and shows the same characteristics as the myoma of other regions

Myxoma Also true myxoma of the ear is very rare The tumor is transparent, of slight yellowish color and contains mucin Polypoid growths of inflammatory origin might be mistaken for myxoma Histologically, the tumor consists of well developed star-shaped cells with intercellular substance, rich in mucin Although treatment is surgical excision a wide margin of safety is required because of the tendency of myxoma to recur

KELOID

Keloid is not considered a true tumor It is usually found over the ear lobe and the retroauricular region The appearance is characteristic as evidenced by elevated scar with increased vascularization and the great tendency to recur The keloid of the ear lobe often forms round tumors, at times of considerable size and may present some difficulty in diagnosis. Surgical removal, followed by x ray or radium treatment is required in larger lesions. Small keloid masses will clear up with radium or x-ray treatment alone (see Chapt III)

NEURINOMA OF THE FACIAL NERVE

Neurinoma of the facial nerve is relatively rare It usually arises in the facial canal and by pressure necrosis of the surrounding bone extends into the mastoid process as well as the tympanic cavity erosion into the external auditory canal has been reported The tumor is round of varying size, and has a broad base Facial paralysis and severe pain are the leading symptoms The growth is often seen in the tympanic cavity through the intact tympanic membrane Facial paralysis may be recurrent Treatment— removal of the tumor, followed by nerve graft if required

Case I W F 24 yrs.
Complete facial paralysis of peripheral type, of several years duration, later followed by hearing impairment of conductive type. No pain. Through the intact tympanic membrane a reddish tumor can be seen in the tympanic cavity in its posterior half The tympanic membrane over this area is protruding but moves freely Radical mastoid operation revealed a tumor of the size of a hazelnut, extending into the middle of the mastoid process, the antrum and the middle ear cavity The facial nerve was destroyed in about 2 cm of its length.

Tumors of the acoustic nerve Tumors of the acoustic nerve are not discussed here since they are beyond the scope of this book

TREATMENT OF BENIGN TUMORS OF THE EAR

Asymptomatic benign tumors of the ear do not require treatment but will frequently be removed for histologic study to verify the clinical diagnosis.

When however benign tumors of the ear obstruct the external auditory canal and impair the hearing or when they are subjected to traumatization and consequent ulceration and inflammation they should be removed surgically Either excision or electrodesiccation is employed according to the circumstances.

TUMORS OF THE EAR ASSOCIATED WITH GENERAL DISEASE

XANTHOMATOSIS

Xanthomata are not true neoplasms but are mentioned for the sake of differential diagnosis

Xanthomata over the pinna and in the external canal are easily recognized by their characteristic yellowish appearance In the middle ear they appear as brown yellowish tumors and on histological examination show the usual foam cells and giant cells Roentgenographs depict areas of diminished density with sharp margins frequently circular multiple, and of varying size. Involvement of the middle ear is usually associated with chronic otorrhea. About 50 per cent of patients with Schüller-Christian syndrome have ear involvement The lesion responds favorably to X ray treatment.

CHLOROMA

Chloroma has been described as an independent tumor but belongs apparently to the leukemias It is found as a firm multiple tumor of greenish color in the pneumatic system of the skull and in the orbit, the vertebrae, and the ribs In the ear region chloroma occurs in the middle ear cavity the mastoid and the petrous pyramid and may be bilateral. The involvement might be extensive and erosion of the sigmoid sinus has been reported (Lubarsch) The labyrinth is relatively resistant to invasion The bone marrow is usually also affected Histologically the tumor consists of round cells with a large nucleus. Occasionally spindle-shaped cells have been seen.

Treatment consists of therapy of the underlying leukemia.

ENDOTHELIOMA

The endothelioma is rare in the region of the external ear It is seen mostly in the form of the lymphangioendothelioma over the pinna, has an irregular papillomatous surface and tends to ulcerate At times, it involves most of the pinna and extends to neighboring structures. The development is relatively slow and generally speaking its malignancy is not as great as that of cancer or sarcoma Recurrences after extirpation are rare Lymphangioendothelioma of the external meatus has been described by Tervaert and DeJong and Hahn as a circumscribed hard tumor Also heman-

gioendotheliomas have been found over the pinna, (Haug Alt) 'E

GLOMUS-JUGULARIS TUMOR

The knowledge of this type of tumor is relatively new and undoubtedly several of these tumors have been classified in the old literature as endothelioma (Winship et al.)

In 1941 Guild described a hitherto unrecognized structure in the human temporal bone for which he proposed the name of glomus jugularis. He describes this structure as "in several respects like the carotid body usually located in the adventitia of the dome of the jugular bulb immediately below the bony floor of the middle ear and near the ramus tympanicus of the glossopharyngeal nerve Usually there is but a single flattened ovoid glomus about 0.5 mm thick Each glomus consists of blood vessels of capillary or precapillary caliber with numerous epithelioid cells between the vessels (Fig 462) Usually the vessels are the more prominent feature of the neoplasm. Innervation and blood supply come from the same trunks that supply the carotid body namely glossopharyngeal nerve and ascending pharyngeal artery "

The first tumor of the middle ear arising from the glomus jugularis was recognized by Rosenwasser in 1945 The patient gave a history of deafness in the affected ear of 10 years duration and of purulent discharge of one month s duration At operation the middle ear was found to be filled with a large purplish mass The tumor was considered benign

Winship Klopp and Jenkins studied sections of several cases either described as glomus jugularis tumors or endotheliomas (including 2 cases of their own) and came to the conclusion that 11 cases are proven to be glomus jugularis tumors Thirteen additional cases in the literature are considered by these authors to be probable glomus jugularis tumors. Four of the proven cases of glomus jugularis tumor are reported to be malignant Winship et al. state that the malignancy of glomus jugularis tumors is determined by the degree of invasiveness the size shape and pyknosis of the nuclei, and the presence of giant cells. Metastasis has been observed in only one case (Winship, et al.)

The glomus jugularis tumor has been described as dark red or purplish, soft, polypoid mass with tendency to destruction of adjacent structures either by pressure necrosis in benign tumors or by invasion in the malignant form. The tumor is more frequent in the middle age group but has also been reported in a child five years old (Bilancioni) and in a man of 78 years



Fig. 462. Photomicrograph of a normal glomus jugularis (X 450) (Courtesy Stacy R. Guild.)

(Robinson) The symptoms are essentially the same as those in cancer but are usually of longer duration The first signs are progressive hearing impairment and tinnitus, at times associated with dizziness, and evidence of a tumor in the middle ear cavity Later a polypoid mass is seen through a perforation of the tympanic membrane with otorrhea. The tumor bleeds profusely after removal or biopsy and has a tendency to recur Facial paralysis and occasionally pain has also been observed in patients having these tumors.

MALIGNANT TUMORS OF THE EAR

CANCER

Cancer of the external ear is not uncommon and occurs as basal cell or squamous cell carcinoma. The latter is more frequent While any part of the concha may be involved the usual site is the posterosuperior part of the pinna (in man) and the concha close to the external auditory meatus (in women) There is great tendency to ulceration so that the cancer rarely reaches any great dimensions. On the other hand cancer located in the external auditory meatus proper can reach considerable size during its slow growth with destruction and invasion of surrounding structures. General metastases of cancer of the ear is rare. The local lymph nodes are occasionally involved The histological picture is the same as that of other carcinomas arising in the skin

In the middle ear and temporal bone the typical form of cancer is the squamous cell carcinoma It is remarkable that squamous cell cancer develops in a region where ordinarily no squamous cell epithelium is found. In many patients previous infections of the middle ear have caused metaplasia of the epithelium into squamous cell type In other cases, invasion of squamous cell epithelium from the external auditory canal into the middle ear took place through a marginal perforation as in cholesteatoma. Reports of primary cancer of the middle ear without previous otitis media could not withstand critical analysis (Schlittler) Also the possibility of secondary invasion into the middle ear has to be considered but most often the neoplasm is so extensive that the original site of the tumor cannot be determined

Cancer of the temporal bone is very malignant grows rapidly and leads to extensive destruction The tumor has a great tendency to extend towards the endocranial cavity The corticalis is often found intact in spite of extensive destruction of the ear The pyramid and especially the labyrinth and the ossicles resist the invasion of the neoplasm longer than the other structures of the ear Loss of labyrinthine function does not necessarily indicate invasion of the tumor into the labyrinth Manasse and Nager found fibrous and osseous degeneration of the labyrinth without invasion by the tumor In Nager's case the whole ear was destroyed except for the labyrinth. The invasion of the tumor into the labyrinth usually occurs through the bony capsule and not through the windows. The facial nerve is *frequently involved at times by compression*, at other times by direct invasion with secondary degeneration and complete destruction. The carotid artery and the lateral sinus have also been found to be invaded by the neoplasm. In one case fatal bleeding occurred from the lateral sinus (Carmalt) Jourdin described one case of fatal bleeding by erosion of the carotid artery In the majority thrombosis occurs before the wall of the blood vessel is destroyed. The dura is fairly resistant but circumscribed infiltration or perforation has been observed (Lucae Zeroni Danziger Ward and Loch) General metastases are apparently very rare and also the regional lymph nodes are very seldom involved. Lange described a basal-cell cancer of the middle ear with general metastases involving the deep cervical nodes, the mediastinum and both lungs.

Symptoms and Diagnosis. Symptoms of cancer of the middle ear will depend on the location and the extent of the lesion Occasionally very small tumors present definite symptoms. Suggestive symptoms are pain, hemorrhage facial nerve paralysis discharge, deafness, and labyrinthine symptoms.

(1) Pain is one of the leading symptoms of cancer of the middle ear It is either a constant dull ache or a rather intense and at times lancinating pain usually worse at night. The discrepancy of the complaints and the local findings is striking The pain may be referred to the ear or to neighboring structures.

(2) Hemorrhage from the external auditory canal or the middle ear is a symptom suggestive of malignancy It may appear as bloody discharge frank spontaneous bleeding and profuse hemorrhage after biopsy or removal of a polyp

(3) Facial nerve paralysis may occur at any

stage of the malignant disease and is suggestive of cancer especially when combined with hemorrhage or pain

(4) Discharge is commonly associated with cancer of the ear and may vary considerably in amount and consistency Unless it is associated with other symptoms it is of little significance However watery discharge especially when it is blood tinged should stimulate search for malignancy

(5) Hearing impairment of conductive type often is an early symptom of middle ear cancer If it comes to invasion of the labyrinth or degenerative changes of the labyrinth the hearing impairment will be of perceptive type and finally lead to total deafness.

(6) Vertigo is rare and occurs in the late stage when the semicircular canals are invaded.

Whenever there are suggestive signs, especially a combination of the above mentioned symptoms intensive search for malignancy should be carried out and biopsy obtained, if necessary, by exploration of the mastoid and the middle ear cavity All growths of the ear even if they appear to be harmless aural polyps should be examined histologically Unfortunately x ray examination of the temporal bone does not give characteristic findings in the early stage of cancer

Case 2. W M 47 yrs.

Drainage from left ear for about three years. "Polyps" removed twice during past year Profuse and prolonged bleeding since first removal discharge from the left ear was blood-stained. Histologic examination apparently not done. Patient complained of pain in and above the ear and bloody discharge. On admission ⅔ of the medial parts of the external canal were filled with slightly bleeding tumor masses. The tympanic membrane could not be visualized. Mastoid process not remarkable on palpation. X rays of the ear showed destruction of the mastoid process with intact corticalis. The pyramide was dense but destruction was not demonstrable The facial nerve was intact Tuning fork 512 was referred to the affected ear and BC was better than AC Biopsy revealed squamous cell cancer Radical mastoid operation was performed. The mastoid process was extensively destroyed. The dura lateral sinus and labyrinth appeared normal. One week after operation patient began x ray therapy (dose not known) following which several necrotic pieces of bone were removed in the course of three months. The discharge was fairly profuse for about 3½ months. Normal looking granulations were seen about four months after operation, but epithelialization of the operative cavity was not complete until about seven months after operation. Granulations were removed for histologic examination nine months after operation and were reported as normal granulation tissue. Patient moved away from the locality ten months after operation and no further information could be obtained

Case 3 W F 72 yrs. (Ward and Loch)

Eczema with occasional drainage from the left ear for several years one year ago increasing tender swelling in front of the left ear "Sore" was found in left external canal that did not heal Bloody drainage. Hearing impairment on the affected side. Weight loss. Patient complained of severe pain in the left ear and the left side of the head. On examination the left external auditory canal was found narrowed filled with bloody discharge. There was extensive destruction of the epithelium with a deep defect in which necrotic cartilage was found Irregular tumor formation was found in the posterior inferior and anterior superior part of the lateral half of the external canal Details of the tympanic membrane could not be distinguished a firm swelling of the size of a hazel nut was found over the zygomatic root and arch. The upper part of the parotid gland apparently was also involved in this tumor Biopsy from the external canal revealed squamous cell epithelioma. Patient received X-ray treatment of the affected area (dose not known) One month later radical neck dissection removal of the parotid gland removal of the temperomandibular joint radical mastoidectomy and removal of the petrous apex with wide exposure of the carotid artery and the dura was carried out. There was localized involvement of the dura but no perforation was seen. The carotid artery was normal. Patient received postoperatively a second course of X ray treatment (2450 r) The postoperative course was uneventful. The pain disappeared

Case 4 W M 72 yrs.

Recurrent basal cell cancer of the right ear and temporal region. Operation of the temporal region May 1918, leaving facial paralysis. Operation right mastoid, May 1924 Removal of right pinna in 1926. Died same year

Histologic examination showed extensive cancer of the middle ear and the external canal. Tympanic membrane destroyed. Ossicles embedded in tumor but not destroyed. Tumor also in apex lateral to carotid canal. Fossa of oval window filled with tumor but labyrinth not invaded. Extensive metastases in liver lungs, pleura vertebrae ribs, and squama

Metastatic Cancer The metastatic cancer of the temporal bone is undoubtedly more

frequent than would appear from the reports in the literature. In routine autopsy these metastases are often not recognized since the temporal bone appears normal on gross inspection and in many cases microscopic studies are carried out only in relatively rare instances. There is reason to believe that the chances of metastatic involvement of the ear are the same as for any other part of the skeleton of comparative size.

The common cancer metastasis to the ear appears as a localized tumor in the bone marrow. The site of the original tumor may be anywhere in the body. The mechanism is apparently the same as for metastasis to other parts of the body. There are usually no clinical manifestations that would indicate the presence of a metastasis in this region since the patient usually succumbs before clinical signs become apparent and X ray films are usually either negative or not characteristic to allow diagnosis of metastasis. Cancer metastasis in the temporal bone is most often found incidentally in the study of temporal bones for other reasons.

In this way the following cancer metastases were found in material from the Otologic Research Laboratory of the Johns Hopkins University.

Case 5 C. M. 71 yrs.
Metastasis in bone marrow of right ear. Original tumor: cancer of stomach. No clinical signs indicating involvement of ear.

Case 6 W. M. 66 yrs.
Squamous cell cancer in bone marrow of left ear. Primary tumor: Cancer of lung with extensive metastasis of internal organs and skeleton. Chief complaint urinary symptoms. No clinical signs indicating metastasis of ear.

Case 7 C. M. 55 yrs.
Adenocarcinoma in left jugular fossa involving mastoid process. Primary tumor: adeno carcinoma of kidney. Metastasis in heart, thorax and in both inferior vena cava and iliac veins. Symptoms of C.V.R. diseases. No ear symptoms.

Case 8 W. M. 41 yrs. (Fig. 463)
Dural endothelioma in right middle ear. Original tumor: dural endothelioma of right frontal and temporal lobe with invasion of bones of skull, meninges, and right sphenoid sinus. First symptom: hearing impairment of conductive type followed by signs of brain tumor. The tympanic membrane was intact. The tumor reached the round and oval window but the labyrinth was not invaded by tumor.

Case 9 W. M. 63 yrs.
Original tumor: Cancer of prostate.
Ear metastasis: In bone marrow of left ear.
Ear symptoms: otolgia and otorrhea ten weeks.

Case 10 W. M. 58 yrs. (Fig. 464)
Original tumor: Source obscure. Possibly cancer of carotid body.
Ear Metastasis: Right middle ear invading labyrinth and lateral sinus, cerebello pontine angle. Compression of contents of jugular foramen.
Ear symptoms: Tinnitus right ear eight years ago, lasted 5 months. Followed by persistent deafness. Vertigo began 7–8 years ago. Severe vertigo with diplopia eight months ago. Dizzy spells twice a week with unconsciousness. Sense of fullness in right ear a few months. Bleeding growth and discharge.

Another form of metastatic cancer of the ear is described as otitis interna carcinomatosa (Schlittler), the cancer invading the acoustic *nerve and its branches on either side but leav*ing the cochlea intact. This form occurs in the so-called carcinomatous meningitis.

SARCOMA

Sarcoma of the outer ear is less frequent than cancer and prefers the middle age patient. Any part of the pinna may be involved but the posterior surface is apparently preferred. Sarcoma appears as a round, well defined tumor with smooth surface and rare tendency to ulceration. It might reach considerable size. Sarcoma of the external canal is rare and may be seen as isolated or multiple tumors of the same appearance as over the pinna.

Case 11 W. M. 36 years.
Two months before examination, several tumors were noticed by the patient over the abdomen and in the lateral part of the left external auditory canal. Examination showed several small round tumors with smooth surface over the right side of the abdomen in an area of about 10 x 15 cm and also several tumors of the same appearance in the left external auditory canal. No evidence of others. Histologic examination showed round cell sarcoma from both sites. Patient was treated with



Fig. 463 (Case 48) The tumor involves the tympanic cavities extensively. Tumor reaches the round and oval windows but the labyrinth is not invaded

X rays (dose not known) and the tumors promptly disappeared. No recurrence after six months. Patient did not return for check up. It was later learned that patient died about eighteen months after treatment. Cause of death is not known (autopsy was not performed)

Sarcoma of the middle ear involves all age groups but is apparently more frequent in the first decade. There is no difference as to sex. The original site of the sarcoma frequently cannot be determined since the patient is usually seen in rather advanced stages. Primary location in the middle ear is (probably) more often found than secondary invasion from

neighboring structures like nasopharynx pa rotid gland base of skull and dura Also metastases from distant sites occur in the middle ear On the other hand metastases from the ear to other regions are apparently rare but have been observed



Fig 464 (Case 4 10) Tumor invasion of the labyrinth through the otic capsule (right lower corner of picture)

The clinical course of the sarcoma is similar to that of the cancer with the exception that

the sarcoma has lesser tendency to ulceration and may reach considerable size It may perforate to the outside or the endocranial cavity and form solid round tumors The destruction of the bone is usually extensive but also here the labyrinth seems to offer more resistance than the remaining parts of the temporal bone As in cancer, invasion into the labyrinth takes place through the bone and not through the round or oval window The dura is not infrequently perforated by the sarcoma and large intradural tumors may lead to compression of the brain. Facial nerve paralysis is relatively frequent and the presence of a sarcoma might not be detected until surgery for the facial nerve is carried out. Fatal bleeding by erosion of the carotid artery has been reported by Hewetson

The most common form of primary sarcoma in this region is the fibro- or osteosarcoma but also melanosarcoma has been seen

Case 12. W M 31 years.
Original tumor Melanotic sarcoma of heel.
Ear metastasis Left ear auditory nerve trunks.
Ear symptoms Three months before death, dizzy spells and swaying No facial paralysis. No otorrhea. One month before death, hearing impairment. Two weeks before exitus marked increase in deafness.

Case 13 W M. 26 years.
Original tumor Melanotic sarcoma of spinal cord.
Ear metastasis Invasion of 8th nerve bilateral. Serous labyrinthitis bilateral
Ear symptoms Right facial paralysis. Weakness right abducens. Vomiting Hearing?

Treatment of Malignancies of the Ear

In the treatment of malignancies of the ear X ray radiation electrosurgery and surgery are employed either alone or in combination. The treatment must be planned individually considering the histology of the tumor, the extent and location of involvement

Radiosensitive tumors are controlled in some patients by roentgen radiation alone. In the majority of these cases it will be best to treat the malignancy first with x rays and to remove the remaining tumor surgically This should again be followed by roentgen radiation

Radioresistant tumors are first approached surgically, but it is advantageous to follow with roentgen therapy

The X ray therapy in the form of the protracted fractionated technic of Coutard or the simple protracted radiation seems to be the procedure of choice and affords good protection of bone and cartilage Location and extent of involvement do not limit the therapeutic use of X rays.

On the other hand surgery is naturally limited and tumors involving the Eustachian tube cannot very well be completely removed by surgery But even in these cases, the removal of the greatest part of the tumor will be of help by narrowing the field where radiation is needed.

Cancer of the middle ear and temporal bone is approached by radical mastoidectomy Dura and lateral sinus should be uncovered and inspected for possible involvement. Also the hypotympanic, perifacial peritubal, and peri labyrinthine cells are explored If the tumor is also located in the petrous pyramid, resection of the apex according to Ramadier or Lempert is carried out with wide exposure of the internal carotid artery In certain instances ligation of the jugular vein and the internal carotid artery is required to allow total removal of the tumor Perforation of the dura should be excised and the dural defect covered with fascia. If there is evidence that the labyrinth is invaded by the malignancy, it should be removed, sacrificing the facial nerve In the presence of facial nerve paralysis, surgery should always be preceded by X ray radiation In spite of the rareness of metastases from the ear scrupulous search for it, especially in the regional lymph nodes, is essential. At the time of the radical operation in the head a radical neck dissection should be done, as in Case 3 A similar case has been operated recently by Ward and Loch with relief of severe and long-standing pain. Invasion of neighboring structures is not uncommon and the plan of operation has to be modified accordingly It is advisable to leave the postauricular incision wide open to facilitate postoperative radiation. In two cases (one free of disease, 1

yr) the wound was left open and 7000 r of unfiltered x ray given directly over the area from which growth could not be removed including dura. Before x ray reaction began a split graft was applied to the granulating surface All of the graft "took" except over non vascular cranial bone The mastoid cavity when not grafted is treated postoperatively in the usual manner Particular care should be taken to avoid drying of the exposed bone Necrotic bone or cartilage may necessitate secondary operation At times, plastic closure of the retroauricular incision is required

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Chapter XVI

TUMORS OF THE LARYNX

I. DIAGNOSIS AND SURGICAL TREATMENT

By

Edwin N. Broyles, M.D.*

The study of tumors of the larynx has interested the medical profession since prehistoric times, but little was known until a satisfactory method of examination of this organ was developed by Emanuel Garcia in 1854. Garcia was not a physician but a singing instructor, and although he presented his discovery to the medical profession of London it was received with apathy and incredulity. Ludwig Turck of Vienna and Johann Czermack of Budapest appreciated the importance of Garcia's discovery and traveled over Europe demonstrating the mirror laryngoscope. The first case of an intralaryngeal tumor removed by the use of the laryngoscope (now called indirect laryngoscopy) was by Victor von Bruns, who in 1861 removed a large polyp from the left vocal cord of his own brother. It was soon learned, however, that the intralaryngeal operations were not successful when dealing with malignant tumors.

Surgery of the larynx was given another great stimulus by Theodor Billroth who on New Year's Eve, 1873, performed the first successful laryngectomy.

Hoarseness is the important symptom of laryngeal disease and, if persistent, is a storm signal which must be heeded. Conditions that prevent normal and proper vibration of the vocal cords on phonation cause hoarseness. Jackson and Jackson list 54 causes (1945). All cases of hoarseness require careful and meticulous examination of the larynx, first by external palpation, then by the indirect laryngoscopy (laryngeal mirror), followed by direct laryngoscopy if necessary. The more common causes of hoarseness are benign and malignant tumors, infections, paralysis or weakness of the laryngeal muscles, trauma, oedema, and foreign bodies. Aphonia is usually associated with hysteria or, in a very few cases, chronic lead poisoning.

Examination

Palpation must include the anterior cervical nodes, the hyoid bone, the thyroid cartilage, the cricothyroid membrane and prelaryngeal nodes, the cricoid cartilage, the upper trachea and the thyroid gland.

Inspection. Before the larynx is viewed the mouth, teeth, tongue, and pharynx are carefully examined. Then the patient is directed to sit up straight with the chest out, mouth open, head extended, and tongue out (Fig. 465 A and B). The tongue is gently grasped with a small piece of gauze, the patient directed to breathe through the mouth, and a warmed mirror of suitable size is placed over the dorsum of the tongue gently pressing back the uvula. Care is taken not to touch the posterior pharyngeal wall. With the reflected light from the head mirror directed on the laryngeal mirror, a view is first obtained of the base of the tongue, the anterior surface of the epiglottis, and the pyriform sinuses. The patient is then directed to say "E"; this raises the epiglottis and discloses the interior of the larynx with the cords, if normal, in adduction. As the posterior portion of the larynx is easier to expose, the normal landmarks and movements should be checked from posterior for-

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ward namely, the arytenoid cartilages and their movement, the posterior commissure the vocal process of the arytenoids the true and false cords, the ventricles, the posterior surface of the epiglottis, the tuberculum of the epiglottis the anterior commissure and the upper trachea (Fig 466) At times, if the anterior portion of the cords cannot be seen the patient is asked to hold his own tongue with a piece of gauze, and on phonation the examiner gently pushes the larynx posterior towards the vertebral column Occasionally a

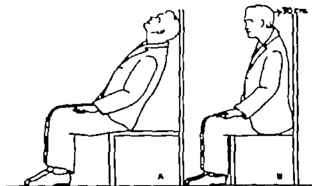


Fig. 465

A. Pen sketch showing the faulty position in which most patients will place themselves for examination of the larynx. The patient is sitting on the forward edge of the examining chair the trunk is inclined backward and the head is thrown back as if to have the neck shaved in a barber's chair It is impossible to get a good mirror view of the larynx with the patient in such a position

B Pen sketch showing the proper position of the patient in which he should be placed for examination of the larynx with the mirror Before he is asked to open his mouth he should be asked to sit all the way back in the chair His head and shoulders should then be brought forward so that his vertex is about 30 cm. or more from the vertical which is shown here as the back of the patient's examination chair (Redrawn from Jackson and Jackson.)

local anesthetic must be applied to the pharynx and soft palate to control an exaggerated gag reflex. Mirror examination of the larynx is used with success on adults and some children but as a general rule children cannot cooperate sufficiently to permit a satisfactory view of the larynx. The patient should be encouraged and treated with gentleness throughout the examination

Direct examination gives a straight way view of the larynx This view is brought about by maneuvering the mouth tongue, and epiglottis of the patient by means of a spatula so that a direct view is obtained of the interior of the larynx. The direct laryngoscope of Jackson is a distally lighted tube that gives good illumination With this type of instrument, the vocal cords do not appear as white as they do with indirect examination The Lynch modification of the Killian suspension apparatus has a proximal lighting as does the

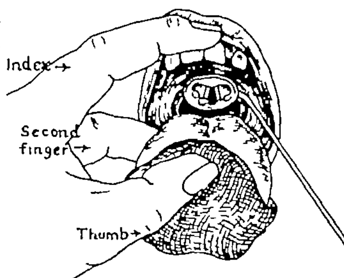


Fig 466. Examination of the larynx with the laryngeal mirror The examiner's left finger holds up the upper lip. The patient's tongue is grasped with a fold of gauze between the second finger and thumb. In drawing the end of the tongue out it is rolled over the second finger which is held high enough to prevent cutting the frenulum on the edge of the lower teeth It is the anterior surface of the epiglottis seen here. The glottic silhouette is black because unilluminated It should be so examined and recorded first A slight shift of the mirror at the second insertion will illuminate the anterior sub-glottic wall. The anterior commissure is hidden as is usual in the reflected image, under the overhang of the epiglottis. The mirror is circular but appears oval because of foreshortening an important fact to remember (Redrawn from Jackson and Jackson.)

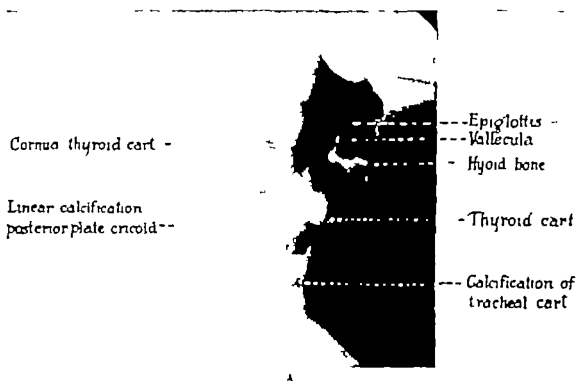
Haslinger directoscope The Jackson laryngoscope is used with or without local anesthesia general anesthesia is needed in most cases when the Lynch or Haslinger scopes are used (Fig 467 A and B)

ANESTHESIA

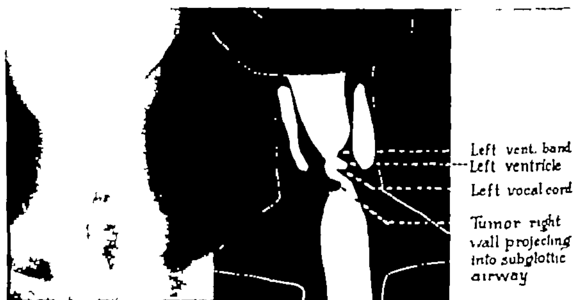
The use of morphine grains $\frac{1}{4}$ and atrophine, grains $\frac{1}{150}$ hypodermically, along with one of the barbituates by mouth decreases tenseness of the patient and lessens the amount of local anesthetic needed The pharynx and larynx

sions until the cut portions of the cords have healed

formed by herniation of the laryngeal appendix through the thyrohyoid membrane to produce



A



B

Fig 468

A Lateral roentgenogram showing how laryngeal cartilages may be identified by calcified areas as landmarks. One such area in the posterior plate of the cricoid might easily be mistaken for a foreign body especially a bone lodged in the hypopharynx.

B Planigram showing left side of larynx normal in contrast to a neoplastic infiltration of the right side Biopsy showed the tumor to be carcinoma (Figs 467 A and B and 468 A and B through the courtesy of Jackson and Jackson. Diseases of the Nose Throat and Ear W B Saunders Co 1945)

Laryngeocele is another congenital tumor or malformation of the larynx (Fig 470) a swelling in the neck Diagnosis is aided by x ray which shows the air filled cavity and





Fig. 469

A Tuberculosis of the larynx. (Courtesy Jackson and Jackson Diseases of the Nose, Throat and Ear W B Saunders Co 1945)

B Photomicrograph showing granulation tissue with typical Mikulicz cells and the deeply stained Unna's bodies (Courtesy F W Dixon Amer Laryng. Assn., 1942)

also demonstrates the ability of the patient to inflate and enlarge the swelling by straining and blowing air into it Incision in the region of the swelling and careful dissection are required The neck of the sac usually can be followed into the larynx through the thyrohyoid membrane

Swellings which resemble tumors may be the result of syphilis (gummata) and tuberculosis of the larynx in the early stage may resemble carcinoma, a submucosal hematoma may resemble a sarcoma A thorough general physical examination, along with blood studies and x rays of the chest, is mandatory in all



Fig. 470. Lateral view of air sac. (Courtesy H. M Taylor Amer Laryng. Assn., 1944)

cases suspected of having laryngeal tumor and solves many an unusual clinical picture

Benign Tumors

Scleroma or rhinoscleroma may occur in the larynx where the characteristic smooth, hard swellings are noted This is a chronic disease apparently due to the bacillus rhinoscleromatis. The tissue changes are limited to the mucosa and submucosa and histologically scattered hyaline bodies, foam cells, and groups of gram negative bacilli are observed. The malady occurs most frequently in people from Poland and the neighboring countries and also in natives of South America and the Indians of Mexico Recently New (1948) et al, have reported an apparent cure of rhinoscleroma

following the use of streptomycin. Local applications of radium in the larynx seem to be of some benefit. Spontaneous recoveries have been recorded. If the obstruction to the larynx becomes too great, a tracheotomy is required.

Papilloma (Fig. 471 A and B) of the larynx occurs both in infancy and adult life, and although the tumors have identical microscopic pictures, the clinical characteristics differ. A papilloma of the larynx in adults, when completely removed, does not recur and does not spread. Papillomata of the larynx in children tend to multiply and to implant themselves on the mucous membrane of the larynx, epiglottis, trachea, or even of the mouth and lips.



Fig. 471
A. Infantile papilloma.
B. Adult papilloma. (Courtesy South. Med. Jour. Vol. 34, No. 3, Mar., 1941.)

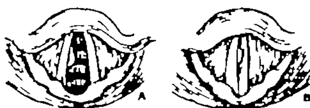


Fig. 472
A. Polyp of right vocal cord; cords are in abduction.
B. Polyp of right vocal cord; cords are adducted. (Redrawn from O. Chiari, Stuttgart, 1916.)

Papilloma of the larynx in children has the peculiar characteristic of suddenly ceasing growth and multiplying activities, usually at the age of puberty. Then they may be removed without recurrence. Many treatments have been tried—x ray, radium, laryngofissure and frequent removal by direct laryngo-



Fig. 473. Typical histologic picture of a vocal nodule or "singer's node." Note thickened epithelial covering and fibrous tissue stroma. (Courtesy C. L. Jackson, Amer. Laryng. Assn., 1941.)

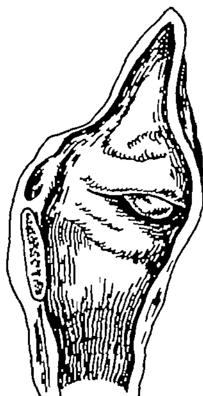


Fig. 474. Polypoid prolapse of the ventricle above the true cord. (Redrawn from O. Chiari, Stuttgard, 1916.)

scopy If the larynx is not kept comparatively clear the patient may die from asphyxia For this reason, the one point in common in all treatments is early tracheotomy The local application of estrogenic hormone (i e Amniotin in oil 10 000 International Units per cc. Squibb) seems to hasten the change from the infantile to the adult type of papilloma when if completely removed it does not recur

In general benign tumors are pedunculated or sessile, and may be angiomas, fibromas, simple polypi or adenomas (Fig 472 A and B) small cysts and polypoid changes of the mucous membrane of the vocal cords

Small cysts as well as thickening in the anterior portions of the vocal cords, commonly

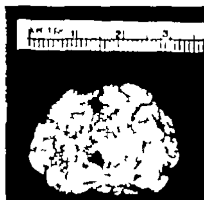


Fig. 475 Lobulated, pedunculated mass removed with a snare from its attachments to the right arytenoid. The diagnosis was extramedullary plasmocytoma.

seen in speakers and singers, are known as singers nodes (Fig 473)

Whitish areas along the cords, known as keratosis, should be regarded with suspicion as many writers consider them premalignant.

Granulomas mentioned above, arising near the vocal process of the arytenoid, are reddish and probably the result of trauma (intratracheal tube)

Occasionally a smooth red swelling occurs above the true vocal cord which is the result of a prolapse of the ventricle (Fig 474)

Neoplasms of the cartilage or bone tumors of the ossified cartilages are slow-growing smooth hard tumors covered with normal mucous membrane

Most of the above growths are removed by direct laryngoscopy either through a direct laryngoscope or a suspension apparatus Tumors large enough to obstruct the laryngeal lumen seriously require preliminary tracheotomy Direct laryngoscopy may be done under local or general anesthesia The use of a suspension or Haslinger directoscope usually calls for general anesthesia. The removal of large tumors also may require a thyrotomy, made on the side affected and a very large chondroma or osteoma of the larynx may necessitate a laryngectomy Occasionally small tumors

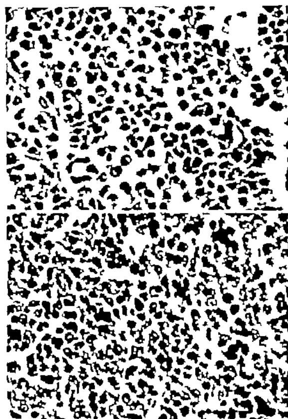


Fig. 476. Photomicrograph of extramedullary plasmocytoma.

are limited to the epiglottis These small tumors and small carcinomas near the tip justify amputation of the epiglottis through a direct laryngoscope or a suspension apparatus

Malignant Tumors

Sarcoma of the larynx has been reported roughtly about one case of sarcoma to 100 cases of carcinoma Strangely enough about 50 per cent of those reported have been fairly large pedunculated tumors These may be removed by direct laryngoscopy, but those not

pedunculated require thyrotomy or laryngectomy (Fig 475 to 477) (Clerf 1946)

Carcinoma of the larynx occurs more frequently in males than females and at almost any age but is more common from the fifth decade on the older the patient the less malignant is the cancer

Most carcinomas of the larynx are of the squamous cell type (90%) and are divided into four grades by some workers treatment is selected according to grade. Others maintain that a single tumor may show so much variation in cellular differentiation that it is of little value to estimate the malignancy of the growth (Fig 478 A–D) The location in the



Fig. 477 Photomicrograph, spindle cell sarcoma of larynx. (Figs. 475 476 and 477 through the courtesy of L. H Clerf Arch Otolaryng 1946.)

larynx also seems to govern the degree of malignancy Squamous cell cancers limited to the true vocal cords are removed with less likelihood of recurrence or rather continuation of growth than the squamous cell carcinomas that have extended into the ventricle or false cord (Fig 480 A & B)

Basal cell carcinomas of the larynx are extremely malignant and should be treated radically They are resistant to radiation therapy An operable new growth in the larynx should never be treated with x ray alone Biopsy makes the diagnosis

Surgical Treatment

The objective of the operation is the removal of the growth with an adequate margin of normal tissue to insure against recurrence (continuation) In carefully selected cases, laryngo-fissure is the operation of choice This operation is contraindicated when the growth involves the anterior commissure has fixed the true cord or has extended to the ventricle or false cord. The operations to be described are not suitable when the growth has become extrinsic or has invaded the muscles or the lymph nodes of the neck. (Fig 479) The patient must be a good operative risk

THE WINDOW LARYNGO-FISSURE OPERATION FOR SMALL MALIGNANT GROWTHS OF THE LARYNX

For the complete removal of malignant growths situated in the anterior third of a vocal cord, the affected cord posterior to the vocal process the anterior commissure, the anterior commissure tendon, and the anterior third of the opposite or unaffected cord (Fig 481 A, B and 482 A and B) must be removed. Anatomical studies have shown the firm attachment of the true cords to the posterior surface of the thyroid cartilage (varies with the degree of cartilage ossification) and the loose attachment of the cords above and below this tendon and to the lateral walls of the thyroid cartilage.

In 1928 Finzi and Harmer recommended a window resection in the lateral wings of the thyroid for the implantation of radium needles in the treatment of carcinoma of the larynx Recently Arbuckle also has advocated window resection for x ray treatment of malignancies of the larynx By removing a portion of the cartilage sloughing and abscess formation associated with destruction of the thyroid cartilage is prevented

Considering the ease of resecting a window in the thyroid cartilage and the firm attachment of the anterior commissure tendon cases of early and localized carcinoma are treated by window or cartilage resection and the removal of the affected cord back to the vocal process of the arytenoid along with the anterior commissure its tendon and the anterior third of the opposite cord

Technique Pentothal sodium is given intravenously as a basal anesthetic and the patient



Fig 478 Histopathology of cancer of the larynx showing lesions of the four grades I II III and IV

A Lesion of grade I in a man 49 years of age This patient is still living and free of disease 15 years afte laryngofissure.

B Lesion of grade II in a man 43 years of age. Laryngectomy was performed in this case and the patient i still living and free of disease 3½ years after operation.

C Lesion of grade III in a man 40 years of age This patient was advised to have a total laryngectomy bu refused and was therefore treated with protracted fractional irradiation given in two courses about 6 months apart but 6 months after the conclusion of the second course, carcinoma was still demonstrable by biopsy and the patie finally consented to laryngectomy The patient is now free of disease almost 3 years after operation.

D Lesion of grade IV in a woman 56 years of age The tissue was taken from a rather deep portion of th right ventricular band The patient is now free of disease almost 10 years after treatment by protracted fractiona irradiation (Courtesy Jackson and Jackson, Diseases of the Nose Throat and Ear W B Saunders Co. 1945

is intubated with a tracheal tube or if desired a tracheotomy is done first under local anesthesia (Fig 483 and 484) The skin of the neck is cleaned with soap and water followed by alcohol and ether A midline incision is made from the thyroid notch to the stern The isthmus of the thyroid gland i and divided, exposing the tracheal i external perichondrium of the thyroi is incised in the midline and gently

PLATE VII

1 Carcinoma of the larynx in a man aged forty two Almost the entire left cord is involved and crosses the anterior commissure involving the anterior end of the right cord. By the anterior commis the growth was removed with a normal margin of 1 cm in all directions. To obtain this much margin it sary to remove the entire left arytenoid

2. Carcinoma of the larynx in a man aged fifty-six, involving the entire left cord. Laryngofissure anterior commissure technic was contraindicated because the arytenoid region was involved and there v

3 Carcinoma of the central portion of the free margin of the epiglottis in a man aged forty two. T recurrence [illegible] laryngoscopic amputation of the free portion of the epiglottis. Such carcinoma [illegible] only in the case of a small early lesion such as this, located margin of [illegible]

4 Bil[illegible] have been due to operation for "malignant goiter" thou had inter[illegible] the sudden onset of the paralysis. The patient, a woman eight was [illegible] ular cannula. Both arytenoids were tilted forward, over posterior [illegible] scopy the arytenoids were found freely movable to cl pressure [illegible] rect laryngoscope was passed into the hypopharynx pos larynx a car[illegible] the cervical esophagus (cf 5)

5 Same [illegible] laryngoscope passed into the hypopharynx and cervical revealed a ca[illegible] luced the paralysis by involvement of both recurrent ne logically th[illegible] was the antecedent goiter The esophageal growth rec a year after [illegible]

6. Edema of [illegible] man aged fifty six. Biopsy from one of these folds had be for both malignant [illegible] fore admission. Endoscopy with the laryngoscope reveal ating fungating lesion [illegible] ll of the larynx. Evidently the edema was part of the per inflammatory zone [illegible] the cancerous process. Irradiation arrested the growth. Rec metastases were fatal [illegible] rward

7 A cupped but not ulcerated squamous-cell carcinoma of the right vocal cord The growth seeme the cordal margin, but direct laryngoscopy revealed extension into the ventricle and into the subglottic re

8 Same patient as shown in [illegible] Lifting of the right ventricular band with the lip of the direct laryngos upward to the right reveal the actual extent of the lesion What seemed in the mirror to be a small grov edge of the cord was really only the margin of a lesion that extended outward on the ventricular flo dragging upward brought into view an extensive subglottic involvement that was invisible in the mirr tent of the lesion thus revealed called for total laryngectomy

9 Ulcerating fungating extrinsic carcinoma of the larynx in a woman aged sixty five A negative o been given by a laryngologist after mirror examination about two months previously Doubtless the that time had not emerged from its primary focus in the hypopharynx.

10. Mirror appearance in the case of a woman aged twenty-seven sent in for the removal of tw papilloma, one on each vocal cord a diagnosis not unwarranted tentatively on reflected appearances al laryngoscope however showed there was only one mass and it looked malignant rather than benign (c

11 Schematic presentation of view through the direct laryngoscope in the same patient as shown ceding illustration. What seemed in the mirror to be two separate growths on the cords is seen to be a growth across the anterior commissure in the subglottic region Biopsy revealed a squamous-cell carc patient was alive and well when last seen five years after laryngofissure done by the anterior commissu

12 Carcinoma probably originating in the sacculus laryngis of a woman aged fifty The left aryepi and left ventricular band are obliterated in one mass that appeared to have sprung from the region b cricoid cartilage and the left wing of the thyroid cartilage. Superficial biopsies had been negative b specimen was obtained from a depth of about 1 cm. a diagnosis of "cystic adenocarcinoma" was made T is still free from recurrence eight years after a course of protracted fractional irradiation.

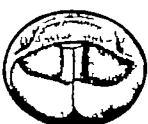
(Plate and legend are used through the courtesy of Jackson & Jackson, Diseases of the Nose Thro 1945 W B Saunders Company Philadelphia)


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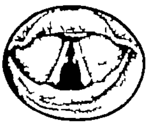
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PLATE VII

(Fig 483 A) On the diseased side, the perichondrium is elevated far posterior, while on the unaffected side, it is carried back only 1.5 above and below the anterior commissure attachment to the opposite side, leaving a small piece of cartilage to which the anterior com

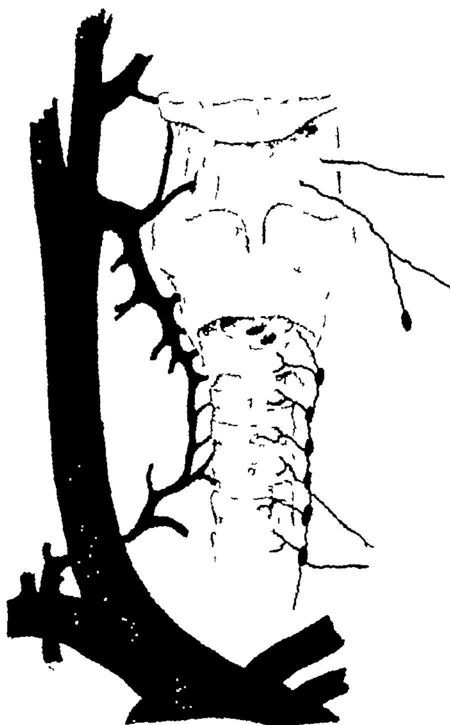


Fig. 479 Blood supply and lymph drainage of the larynx

cm to 2 cm A mastoid curet then peels away the cartilage exposing the membrane of the intralaryngeal muscles (Fig 483 B) The cartilage is then resected past the midline, missure tendon is attached. When the thyroid cartilage has ossified bone rongeurs may be required The window is carried far back on the diseased side (Fig 483 B) Interrupted

triple zero chromic catgut sutures outline the resection on the good side and an incision is made inside the suture line (Fig 484 A) The resected flap is turned back and the interior is carried back on the affected side. Routinely this should extend to and include, the vocal process of the arytenoid, the false cord, ventricle, and true cord The complete resection



Fig. 480

A Tomograph showing adenocarcinoma of the larynx.
B Gross specimen of adenocarcinoma of the larynx. (Courtesy Gordon B New Amer Laryngol. Assn. 1941.)



Fig. 481

A. Cross section of the anterior commissure region of a young adult larynx above the false cords (×20) (1) attachment of anterior commissure tendon (2) thyroid cartilage (3) perichondrium (4) ciliated epithelium (5) numerous glands

B. Section approximately 3 mm. lower (×20) (1) anterior commissure tendon (2) anterior commissure (squamous epithelium) (ciliated epithelium in folds) (3) perichondrium.

of the larynx and the growth inspected (Fig 484 B) If it is of such size that it can be completely removed along with a margin of normal tissue the sutures are placed as the incision then removes the diseased cord ventricle and false cord the anterior commissure and the anterior third of the good cord (Fig 484 C)

The perichondrium is closed with interrupted

sutures of plain 00 catgut The extralaryngeal muscles, subcutaneous tissues and the skin are likewise closed

some handling of cartilage and changes it to a soft tissue operation. Although most of the thyroid cartilage is removed, there remains

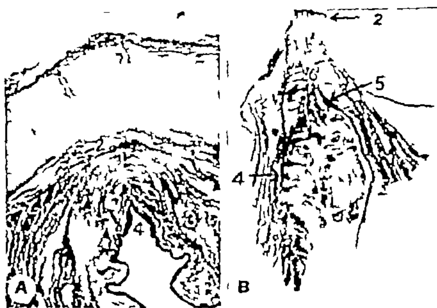


Fig 482

A. Section approximately 12 mm lower (×20) (1) Anterior commissure tendon no fixation into thyroid cartilage, (2) perichondrium almost continuous, (3) mass of elastic tissue (4) anterior commissure (squamous epithelium)

B Cross section of the anterior commissure region of a male 62 year-old early carcinoma, left vocal cord (×10) (1) Anterior commissure tendon (2), thin strip of thyroid cartilage (3) mass of elastic tissue (4) carcinoma extending deep to perichondrium (5) hyperplasia of mm. on opposite cord (6) anterior commissure (in anterior ciliated epithelium, in posterior squamous epithelium) (Figs. 481 and 482 Courtesy Ann. Otol Rhin. and Laryng. June, 1943 vol 52 no 2.)

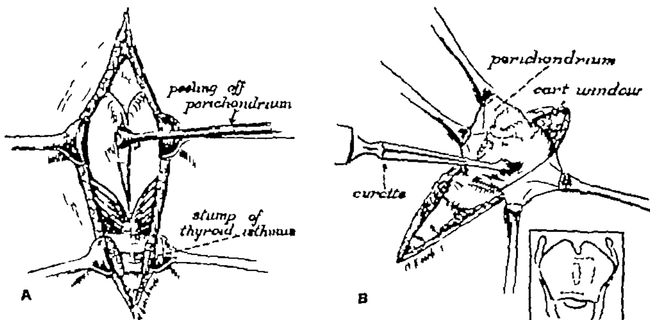


Fig. 483 Laryngofissure

A. Skin incision and exposure after external perichondrium has been resected.
B Removal of the cartilage with mastoid curet. Insert shows window resection on normal and diseased side.

A tracheotomy tube is left in place for twenty-four to forty-eight hours

This technique does away with the trouble-

good breathing space due to the pull of the extralaryngeal muscles, the hyoid bone, and the cricoid cartilage

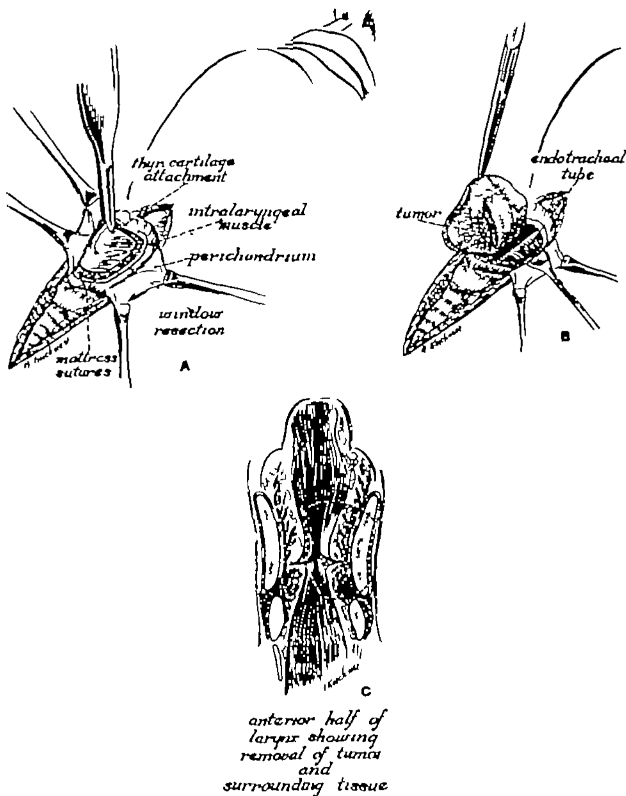


Fig 484

A. Exposure of the muscular larynx showing the anterior commissure s firm attachment to the thyroid cartilage and the interrupted sutures placed around window resection
B Opening the larynx from the non-diseased side
C Shows amount of tissue removed, posterior view
(Figs. 483 and 484 used through the courtesy of Southern Medical Journal, 42 825–827 1949)

This operation gives a dry field for inspection of the interior of the larynx and a wide exposure for removal of early growths. When there is fixation of a vocal cord or an arytenoid or evidence that the growth extends to the cricothyroid membrane, a more extensive operation is necessary of the lymph nodes of the neck for any hope of cure. (See Wookey Operation, Chapt. XII)

As a result of our experience (Crowe and Broyles, 1938) we have evolved the following one-stage operation for total laryngectomy, which is free from shock and other postoperative complications. The success of the operation depends upon the most rigid adherence to the following rules

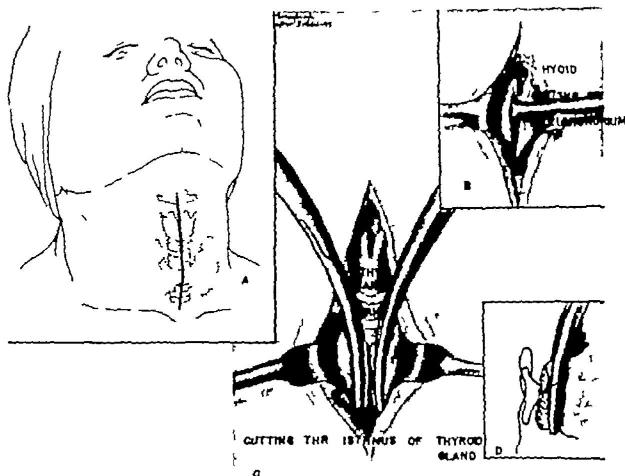


Fig. 485 Laryngectomy

A. The incision is in the midline and extends from the hyoid bone to the lower border of the thyroid gland isthmus.

B. The sterno-hyoid and sterno-thyroid muscles are gently pushed aside exposing the thyroid cartilage, cricothyroid muscles, trachea, and thyroid gland. To avoid crushing or tearing the neighboring muscles and fascia the larynx is skeletonized by peeling off the perichondrium and everywhere making the dissection as close to the trachea as possible.

C and D. Method of dividing and ligating the isthmus of the thyroid gland

LARYNGECTOMY

For more extensive growths the subperichondral laryngectomy operation, described by Crowe and Broyles, has been of great use. This operation is not suitable for the removal of growths that have extended beyond and outside the larynx. The more advanced cases require extensive block removal with resection

1. The growth must be operable or intrinsic. The operation we propose is not suitable when the cartilages are invaded, the false cord is involved, or the neoplasm has spread to the muscles and lymph nodes of the neck.

2. The patient must be a reasonably good operative risk.

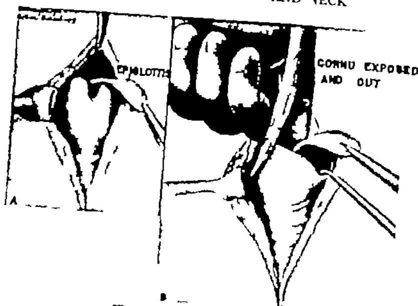


Fig. 486. Laryngectomy (cont.)

A and B By rotating the larynx the cornu first on one side and then on the other is exposed and cut, the artery and vein ligated with chromic catgut (size 00) and the pharynx opened by dividing the thyrohyoid membrane. The interior of the larynx is inspected for the subglottic extent of the growth after which the pharynx and larynx are both packed with gauze to prevent aspiration of blood or mouth secretions.

Fig 487

A The mucous membrane on the posterior surface of the larynx and in the pyriform sinuses is carefully removed and used to close the pharyngeal defect

B D section of membrane for closure of the pharyngeal defect

C Trachea is severed from the larynx above first cartilage Just before the larynx is cut free the trachea is pulled forward and anchored to the surrounding muscles, as shown in Fig. 488 A with chromic catgut (size 0)

3 Great emphasis is placed on preoperative elimination of infection in the sinuses, tonsils and particularly the teeth and gums

4 The anesthesia is a combination of pentothal sodium administered intravenously and procain locally If the growth interferes with

breathing, a tracheal tube is inserted under local anesthesia before pentothal sodium is given, if not, the trachea is opened at a later stage in the operation

5 The operative procedure is based on sound surgical principles. Every effort is made to avoid traumatization with clamps, retractors, and sutures Bleeding is controlled with ligatures, instead of the high frequency cautery because wound infection and a prolonged, uncomfortable convalescence often follow the use of a cutting or coagulating current Closure is made that prevents leakage of mouth secretions into the wound or trachea. Pockets or dead spaces are avoided the smallest size chromic catgut is used and the only drain left in the wound is a piece of rubber tissue smaller than a pencil flattened and placed in the midline The drain is shortened and cut off each day and removed on the third day after operation The wound is not probed suctioned or irrigated because these procedures introduce skin organisms.

6 Before the mucous membrane flap closing

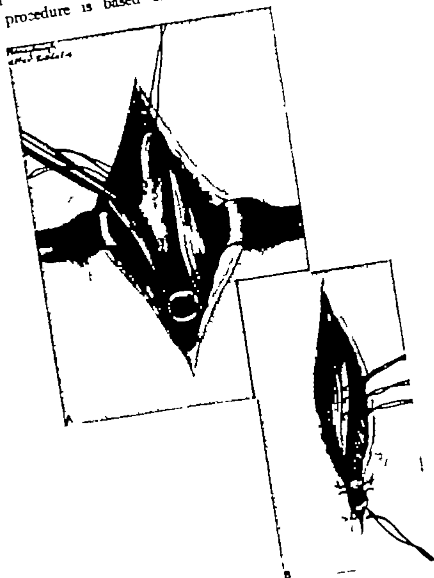


Fig 488

A and B The most important feature of the operation is shown interrupted chromic catgut sutures (size 00) include the mucous membrane flap the mucous membrane of the pharynx and a little of the undersurface of the sternohyoid muscle. When tied the muscle covers the line of incision and prevents leakage of saliva or food into the neck wound. To get this result however the wound must be closed without tension on any of the sutures. (Figs. 485–488 Redrawn from S. J Crowe and Edwin N Broyles. Ann. Otol. Rhin. and Laryng Vol. 47 No 4 Dec. 1938.)

off the pharynx is sutured in place, a small soft rubber catheter is passed through the nose and half way down the esophagus. Fluids are given intravenously during the first twenty four hours, and thereafter are introduced into the catheter with a syringe. On the third day after operation if there is no evidence of leak age or wound infection the feeding tube is removed and the patient given soft diet period these patients need rest, and too much nursing and too many dressings are often detrimental

The wound which is closed tightly with the exception of one small drain in the midline, is carefully watched and at the first sign of infection, the skin sutures are removed and the superficial layers opened This occurs with surprising infrequency

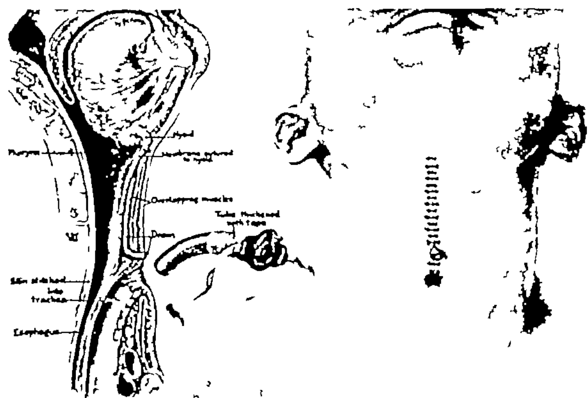


Fig. 489 One small flattened roll of rubber tissue is placed in the midline This is the only drain necessary since no pockets or dead spaces have been left anywhere in the neck. The wound is then reinforced by overlapping the sternohyoid and the remains of the sternothyroid muscles After removing all subcutaneous fat, the skin is drawn into the trachea and loosely sutured The tracheal tube, thickened with tape, holds this skin in place. The wound is closed but the skin incision must be opened at the first sign of infection. If there is no infection the rubber tissue drain is gradually withdrawn and removed entirely on the third day If the tracheal opening ever becomes too small the skin around the lower half is elevated and the underlying anterior wall of the trachea removed with a high frequency cutting current (Courtesy Ann. Otol. Rhin and Laryng Vol. 47 No. 4 Dec 1938.)

During the operation the foot of the table is elevated about eighteen inches and suction is used to prevent aspiration of blood or mouth secretions After the operation the patient is made as comfortable as possible in bed with two or more pillows under his head A special nurse is required to keep a moist cloth over the tracheal tube and to keep his trachea clear by frequent suction During the postoperative

The illustrations show the operative technique (Fig 485–489) If the operation is properly done, there is little loss of blood, no shock and the patient usually sits up or gets out of bed on the second day The feeding tube is removed on the third day and the patient is usually able to leave the hospital two weeks later The incidence of postoperative complica tions shock pneumonia cough and profuse

mucopurulent tracheal discharge, are in direct proportion to the care with which the above rules are followed.

Other important factors which insure a good result are simple surgical principles as regards traumatism of tissues, hemostasis, and post operative treatment, great care to close the pharynx tightly to prevent leakage of mouth secretions into the wound or trachea. The dissection is made with a knife and hemostasis secured with the smallest chromic catgut ties, rather than electrosurgery Fluids are given postoperatively through a small soft rubber, nasal catheter which extends only half way down the esophagus. This catheter is removed on the third day if there is no leakage of mouth secretions into the wound the patient is encouraged to get out of bed on the second or third day, a special nurse is in constant attendance until the feeding tube is removed and longer if tracheal secretions are troublesome

The results of x ray or radium treatment while sometimes very effective are still too uncertain to warrant their substitution for surgery when the growth is operable but may be a valuable aid after operation

Keep In Mind

Hoarseness in a child may also be due to a foreign body in the upper esophagus or, in an adult, to a new growth of the hypopharynx.

In treating acute infections of the larynx keep the possibility of diphtheria in mind and in case of doubt, give antitoxin

The absence of teeth aids direct laryngoscopy

Preliminary medication decreases the amount of local anesthesia

A careful microscopic study of all tissue removed at operation is mandatory

A carcinoma is larger than you think

II. RADIATION THERAPY OF CARCINOMA OF THE LARYNX

By

Mitchell H. Miller, M D *

Radiation therapy for carcinoma of the larynx began with the work of Coutard and Regaud who reported encouraging results from exposure to deep x ray Since then, various reports, notably those of Lenz (1935, 1947) have emphasized the suitability of x ray therapy not only in laryngeal cancer but in pharyngeal malignancy as well Arbuckle (1947) has recently reported his results using deep x ray therapy preceded by surgical removal of the thyroid cartilages. Eight of eleven cases so treated survived five or more years without evidence of cancer

The experience at the Kelly Clinic during the decade from 1934 to 1943 inclusive, reveals interesting features of the applicability of radiation therapy in the treatment of cancer of the larynx There were in this period thirty four patients whose status was known at the end of five years Twelve of the thirty-four showed no palpable evidence of lymphatic spread on admission The other twenty two in whom metastatic nodes were evident before treatment were dead within five years, all succumbing to the disease In nearly all of these the metastatic nodes were multiple Of the twelve in whom the primary tumor was the only local finding five were known to be alive five years after treatment and three died of other disease in a shorter interval, with no evidence of cancer One other patient first treated in 1937 had a recurrence in 1941 and was again treated with irradiation A second recurrence appeared in 1942 and was again irradiated this patient died in 1943 twenty

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From the Kelly Clinic Baltimore Md.

months after the last treatment and at that time was free of cancer Three patients died of cancer in less than a year

It was apparent on examining the records of these patients that in two of the frank failures the tumor was extensive involving the true and false cords and the lateral pharyngeal wall. The third patient had growth on both true cords with no evident extrinsic disease. He received only a minimum amount of gamma ray therapy and improved, and was temporarily lost sight of returning only when the cancer had become advanced.

These records also indicate that only in those cases where treatment was pushed to heavy dosage was there any lasting benefit. This agrees with the experiences reported by other observers e g., Arbuckle ordinarily uses

RESULTS OF IRRADIATION THERAPY IN 34 CASES OF CANCER OF THE LARYNX TREATED AT THE KELLY CLINIC FROM 1934 TO 1943 INCL.

Cases Without Metastasis Receiving More Than 5000 r of X Radiation on Skin and/or More Than 10,000 Millicurie Hours-Radium

HISTORY NO.	DECADE	EXTENT	BIOPSY Dx	PER DAY	TOTAL DOSE	Ra APPLICATION MC. HR.	SKIN OBJECT DIST	RESULT
27286	5th	R & L cords	epidermoid	200	5700			
					6 mos.			
				200	4000			L & W—2 yrs. later
29836	8th	L. cord	epidermoid	300	3250	10 700	1 in.	L & W—5 yrs.
33046	3d (♀)	epiglottis	epidermoid	300	7000			L & W—5 yrs.
25912	6th	R & L false cords	squamous	300	10 000			
					6 mos.			
				300	5000	18 000	2 in	L & W—5 yrs.
25014	8th	R. cord	squamous	300	5000			L & W—5 yrs. (followed by electrocautery)
38395	7th	R cord	0	600	8000			D—1 yr cerebral accident no carcinoma
30340	8th	L cord	0	200	4000			
					2 mos.			
				250	2250	6.5 gm. sec. B ray		D—2 yrs. arteriosclerosis no carcinoma
22167	6th	L. larynx, false cords & epiglottis	squamous			14 000	1 in.	D—1 yr of carcinoma
24614	th	Whole larynx	squamous			21 000	1½ in.	D—1 yr of carcinoma
25624	4th	R & L cords	epidermoid			22 000	2 in.	D—1 yr of nephritis no carcinoma
26419	th	R & L cords	epidermoid			15 000	2 in	D—1 yr of tumor
Cases Without Metastasis on Admission But Developing Metastasis Later								
31269	7th (♀)	R arytenoid	epidermoid	250	3500 (1937)			
		Recurrence		500	3000 (1941)			
		Recurrence with palpable node		1000	5000 (1942)			D—1943 of strangulated hernia—no carcinoma
Cases With Metastasis When First Seen								
Total 22—None surviving more than 2 years—all dying of tumor								

SUMMARY OF RESULTS AS REPORTED IN THE LITERATURE

	TOTAL CASES	NO. WELL 5 YRS OR MORE	PER CENT
New (overall)	446	328	73 5%
Blady and Chamberlain			
Irradiation	46	23	59%
Hare and Hoover			
Surgery prior to 1940	14	9	64%
Surgery after 1940	16	12 (1 5 yr)	75%
Irradiation prior to 1940	15	3	20%
Irradiation after 1940	20	8	40%
Lenz			
Irradiation	110	30	27%
Kramer			
Irradiation	26	22	85%
Cutler			
Irradiation	107	37	35%
Miller			
Irradiation	34	8	24%

2300 r units or more of x ray to each side of the neck In our series the dose reported is the total skin dose delivered to the region of the larynx It is apparent that only those given either more than 5000 r units of deep x ray with or without substantial gamma ray by radium pack showed any lasting benefit from therapy It may be that when one takes into account the variation in technique and filtration, as well as other variable factors involved in administering irradiation therapy, that inadequate dosage to the neoplasm is more the rule than the exception and that, as more powerful and penetrating rays come into usage, improvement in results will occur

In the extensive or inoperable group palliation is all that irradiation therapy would appear to offer yet the palliation often grants prolongation of useful and comfortable existence of the individual and this form of therapy should certainly not be neglected.

The accompanying table gives a summary of the results of irradiation therapy in thirty four cases of cancer of the larynx treated between 1934 and 1943 inclusive

Prognosis

The prognosis of treatment of carcinoma of the larynx depends upon the type of tumor and the stage of advancement of the disease when treatment is begun. At the present time there are no uniform criteria outlined in the literature for comparison of end results A resumé of a number of reports will give the reader some idea of the outcome of both surgery and radiation therapy in the treatment of cancer of the larynx.

G B New (1946) reports the end results in 568 patients treated for cancer of the larynx at the Mayo Clinic from 1934–1943 Seventy eight and five tenths per cent (446) were operated and 21.5 per cent (122) irradiated Of the 446 47 7 per cent (213) had laryngectomy giving a 60 per cent five year cure rate. Forty-one and two-tenths per cent (184) underwent thyrotomy and yielded 83 6 per cent five year cure. Eleven and one tenth per cent (49) were treated by laryngeal suspension surgical excision of the growth by diatheramy or insertion of radon seeds Of all patients in this group so treated and traced 91 7 per cent lived five years or more The high percentage of cases in this group were neoplasms of lower grades of malignancy (82%, grade I and II) accounting for the high survival rate Seventy three and five tenths per cent of all patients subjected to operation and traced lived five years after surgery

Of the 122 of New's cases treated by irradiation 6 9 per cent lived five years or more

The author does not state what type of patients received irradiation but intimates that they were all unfit for radical surgery New maintains that the grading of the tumor affects the survival rate, a point which many authors doubt

Blady and Chamberlain (1944) report the end results of forty-six cases of cancer of the larynx treated by roentgen irradiation from 1931 to 1937 inclusive. Twenty three of these cases had intrinsic laryngeal involvement only The five year net results in this group were 59 per cent Thirteen cases were classed as extrinsic laryngeal cancer The net five-year result in this group was 25 per cent The dose of roentgen therapy used was 3500 r in air, to each of two skin fields.

Hare and Hoover (1946) reporting from the Lahey Clinic, give the results from surgery and irradiation therapy These authors maintain that laryngofissure is the treatment of choice in early cases although only one out of four cases admitted are suitable for such treatment Laryngectomy is second choice, and radiation therapy is a treatment to be used only in advanced cases. Of nine patients operated on by laryngofissure prior to 1940 six survived the five year period giving a good result in 66 6 per cent Prior to 1940 five cases were treated with laryngectomy three survived the five year period with a 60 per cent good result This gave an average operative five-year salvage of 64 per cent prior to 1940 After 1940 six patients were operated on by laryngofissure and all six remained well for one to five years, giving a cure rate of 100 per cent After 1940 ten patients were operated on by laryngectomy with a one to five year survival of six, or 60 per cent Since 1940 the overall operative good results were 75 per cent

The technic of radiation therapy used by these authors is as follows

The position of the cord is marked with a lead marker and roentgenogram made to insure the direct radiation to the cord The treatment factors were 200 Kv 1 mm Cu 1 mm Al, and 50 cm T.S D Three portals were chosen, one anterior and two lateral, through which 300 r were given to each portal on successive days then 150 r per portal every day until each portal receives 3000 r providing the skin will tolerate this much radiation. Smaller doses are given if palliation only is the aim. The results from radiation therapy were divided in two groups those treated from 1934 to 1939 and those from 1939 to 1944 because larger doses were given after 1940 Prior to 1940 the cases received an average of 5000 r Out of fifteen cases so treated three survived the five year period, giving a five-year salvage of 20 per cent. After 1940 the patients received from 6000–9000 r Out of twenty cases so treated eight survived one year or more giving a salvage of 40 per cent.

Maurice Lenz (1947) reported a study of 128 cases of cancer of the larynx treated between 1931 and 1941 These cases were reviewed in 1946 In conclusion the author states — Roentgen therapy in early cancer of the cords gives as high a cure rate and a better voice than laryngofissure. We recommend roentgen therapy in all cancers of the vocal cord except when the cancer has extended subglottically or into the arytenoid cartilage. In these cases we prefer laryngectomy followed by roentgen therapy if clinically there is persisting cancer or if the laryngectomy specimen shows that removal was incomplete Roentgen therapy in cordal cancer with definite fixation of the arytenoid cartilage has succeeded in a small number of cases but should be substituted for laryngectomy only if there are valid reasons for avoiding this operation If the arytenoid is partially movable a trial with roentgen therapy is indicated. If roentgen therapy fails, laryngectomy can be done without fear of delayed healing For cancers of epiglottis, ventricular band and anterior portion of the aryepiglottic folds roentgen therapy should be employed even after fixation of the arytenoids and occurrence of lymph node metastasis

Cancer of the pyriform sinus usually invades the arytenoid cartilage and early metas-

tasizes to cervical nodes. Roentgen therapy has failed to cure most of these cancers Laryngectomy and postoperative roentgen therapy might yield better results

Of the 128 cases reviewed three patients were discarded because they received one-half of the adequate x ray dose, and fifteen others were discarded because they were lost track of or died of intercurrent disease leaving 110 cases studied in detail. To substantiate the above conclusions, the author gives the following statistics

An over all of 27 per cent of the patients remained free of disease from five to fourteen years.

In breaking down the results according to microscopic grading the following results were found to have been obtained 27.2 per cent of the well-differentiated epitheliomas remained well over five years 26 per cent of the moderately well-differentiated epitheliomas and 36 9 per cent of the undifferentiated epitheliomas remained well for five years or more. Lenz feels that the prognostic significance according to histology is poor It is interesting to note the influence of location on prognosis.

	No. Treated	Free from Ca 5-14 yrs
Invasion of arytenoid		
Incomplete or no fixation	42	50%
Complete fixation	68	12 3%
Clinically metastatic lymph nodes		
Patients without nodes	57	33%
Patients with nodes	53	15%

The author points out the grave significance present when the arytenoid cartilage or nodes are invaded

The radiological technic and treatment factors are as follows

Tumor dose consists of 5700–7000 r in 5–6 weeks given daily except Sunday Treatment factors are 20 r min using 200 Kv 2 mm. Cu filter 50 cm T.S D Each side of the neck is given 3000-3500 r to a field 8 x 10 or 6 x 8 cm.

Rudolph Kramer (1947) reports the end results of the roentgen treatment of limited laryngeal cancer Twenty two of twenty-six cases were free of disease for three years or more, giving a three-year salvage of 85 per cent, which he holds is as good as the best figures for laryngeal fissure

Max Cutler (1948) gives the following technics for what he calls concentration radiation therapy

1 For early intrinsic carcinoma of one or both true or false cords with complete or partial mobility 400 Kv, 5 ma, 5 mm Cu filter 84–115 cm. T.S.D , single lateral port 5 x 5 cm. gradually diminishing to 3 x 3 cm , hvl intensity 7 r/min 2 equal treatments daily for eighteen days, beginning with 100 r twice a day and increasing to 250 r twice a day Total dose is 6000 r on the skin

2 For extensive intrinsic and extrinsic carcinoma with or without cervical metastases and partial or complete fixation 400 Kv 5 ma 7–8 mm Cu filter 75–80 cm. T.S.D , single lateral port 7 x 5 cm , diminishing to 4 x 3 cm hvl intensity 6 r/min , 2 equal treatments for 18 days, giving 85 r twice daily increasing to 275 r twice daily, to a total skin dose of 6500 r Metastases too extensive to be in the field are given additional irradiation

The criteria for selecting the treatment are

A. General—age and general condition life expectancy and presence or absence of organic disease

B Extent of Lesion—If very advanced, palliative irradiation only is given

C Site of Origin—Lesions arising in the ventricle false cords or base of epiglottis are radiosensitive Subglottic lesions are radioresistant Sensitivity of tumors of the true cords depends on extent and degree of infiltration

D Microscopic structure—The prognosis cannot be predicted except that anaplastic malignancies give bad outlook.

E Mobility of laryngeal structures is of good prognostic value except fixation is often due to inflammation especially after biopsy

Cutler gives the following five year results

tandardization is necessary to give an accurate nd adequate comparison of the value of sur ery and irradiation therapy, particularly in he early cases.

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Chapter XVII

TUMORS PRIMARY IN THE NECK

CONGENITAL ANOMALIES AND VESTIGIAL RESTS

A proper interpretation of the congenital anomalies and vestigial rests that are encountered in the neck requires an understanding of the embryology of these structures so that a rational approach may be made to the treatment of such lesions as branchiogenic cyst branchial fistula branchiogenic carcinoma thyroglossal tract cyst and fistula aberrant thyroid tissue aberrant salivary tissue and aberrant parathyroid adenomas. The reader is referred to Chapter II which covers the embryology of the head and neck.

Vestigial rests in the neck fall into four groups (1) branchiogenic fistulas (2) branchiogenic cysts, (3) branchiogenic carcinomas (4) thyroglossal tract cysts and fistulas

None of the theories of embryological development completely explains the origin of all the different varieties of cysts and fistulas encountered in surgery of the neck.

Branchiogenic Cyst, Fistula and Carcinoma

During the years from 1926–46 seventy cases were operated or had tissue removed for pathological examination in the Johns Hopkins Hospital these patients form the basis of this study There were numerous other patients having a clinical diagnosis of either branchiogenic cyst or fistula while in the hospital for another condition consequently the fistula or cyst was not treated Also several patients receiving the same diagnosis refused surgical care

Branchiogenic Fistula

CLINICAL BEHAVIOR

Branchiogenic cysts and fistulas are observed any time from birth to old age The youngest child was two months of age and the oldest patient was eighty-one at the time of first examination There were seventeen fistulas, forty-eight cysts, seven branchiogenic carcinomas, and one cylindroma. The length of time from the first symptom until the patient was admitted for treatment varied from six weeks to twenty-four years Branchiogenic fistulas and cysts occur along the anterolateral side of the neck from the supra-auricular (Fig 490) region to the clavicle whereas, thyroglossal tract cysts or fistulas occur in the midline of the neck. For convenience, we have divided the branchiogenic cysts and fistulas into three groups according to their location upper middle and lower (Hamilton Bailey) The upper location extends from the supra auricular region to the angle of the jaw the middle lies between the angle of the jaw and the level of the thyroid cartilage, and the lower from the thyroid cartilage to the clavicle. There were five cases in the upper forty-five in the middle and thirteen in the lower locations The seven branchiogenic carcinomas all occurred in the middle location. Both branchiogenic cysts and fistulas may be bilateral there were six bilateral fistulas, five bilateral cysts, and two patients had a cyst on one side and a fistula on the opposite side. When the cysts and fistulas were unilateral, the right side was more commonly affected than the left Males were more frequently affected than females.

In the literature *branchiogenic fistulas* are divided arbitrarily into primary or congenital (which is usually present at birth) and secondary fistulas which result from the drainage of a cyst. The latter may be properly called a branchial sinus. Branchial fistulas fall into three distinct types (1) complete fistula with an outer and inner opening into the pharynx, (2) incomplete internal fistula with an opening into the pharynx only (3) incomplete external fistula with an outer opening only

Four of the five cases in the upper location

were bilateral. Two cases had bilateral fistula in the preauricular area, the fistulous tract extending about 2 cm. into the substance of the parotid gland from the skin. Both gave a history of the fistulous tract being present at birth, frequently discharging a secretion or fluid, and occasionally the ostium closed over, causing inflammation of the surrounding parts. Dilatation of the ostium by the patient or incision by the local physician resulted in subsidence of symptoms. On removal these fistulas were found to extend into the substance of the parotid gland. In each case no lymphoid tissue was noted on histological examination in the wall of the sinus tract. Cysts and fistulas in this location arise from the first branchial arch.

The greater percentage of these fistulas have an orifice situated along the anterior border of the sternomastoid muscle in the lower third of the neck. Occasionally the orifice may be along the posterior border of the muscle. There were five cases that had a complete fistula, the tract extending from the skin of the neck upward along the anterior border of the sternomastoid muscle opening into the pharynx in the region of Rosenmüller's pouch, just above the tonsil. One patient had two sinus or fistulous tracts on the left side of the neck, one opening in the middle location, the second opening just above the clavicle. When the tracts were injected with an opaque substance roentgenographs demonstrated two distinct tracts, one extending upward just beneath the skin, the second taking a deeper course beneath the enveloping layer of the fascia of the neck. A forty-one-year-old white male gave a history of having had a cyst of the neck excised and drained three years previously, resulting in a complete fistulous tract with one internal opening into the larynx and a second into the pharynx. Plastic procedure was necessary on the larynx after the fistula was completely excised.

The symptoms produced by a fistula are usually annoying discharge of mucous which may be continuous or intermittent, and recurrent attacks of inflammation in the fistula. The inflammatory attacks may follow an upper respiratory infection or mild trauma, or without any apparent reason. It is often during these attacks that the patient seeks relief.

The orifice of the fistula in most cases is small and inconspicuous, except when inflammed. One patient with a complete fistula complained that his beer and coffee would drain out through the fistulous tract and desired it to be repaired for that reason. Hamilton Bailey states that a few cases have been described with a complete fistula so large that



Fig. 490. Sinus arising from first branchial cleft. This preauricular sinus was bilateral and present since birth. Example of first branchial cleft sinuses and fistulas.

the patient's main complaint was loss of bread crumbs and other particles of food through it, a very broad statement especially from a conservative Englishman. Fistulas with an opening in the trachea may give rise to an air sac and present the features of a tracheocele otherwise described as an aerial goiter. One such case was noted in this group.

Some patients complain of vagal symptoms when the fistulous tract becomes infected or is being probed or injected, i.e., uneasiness, palpitation of the heart, pallor, coughing and vomiting.

Branchial fistulas that occur below the level of the hyoid are generally covered with skin,

superficial fascia platysma muscle, and the enveloping layer of deep cervical fascia as internal carotid arteries and ventral to the 9th and 10th cranial nerves They are fre



Fig 491 Injection of branchiogenic fistula with lipiodol in preparation for roentgenography

they course along the anterior border of the sternomastoid muscle At the level of the hyoid they frequently pass over the common carotid artery and between the external and quently in close relationship to the internal jugular vein If the fistulas are complete, the tract will probably turn medially to enter the pharynx at Rosenmüller s pouch

HISTOLOGY

The fistulous tract is usually lined with squamous or low columnar epithelium. Cilia may be noted after repeated infection. The wall of the tract may be rather thick and contain lymphoid tissue, a finding noted in most orifice A very small ureteral catheter or a fine-nozzled syringe such as is used to irrigate a lacrimal duct, is introduced into the tract. As the injection is made through the catheter, the patient may complain of vagal symptoms which usually disappear within a few moments.

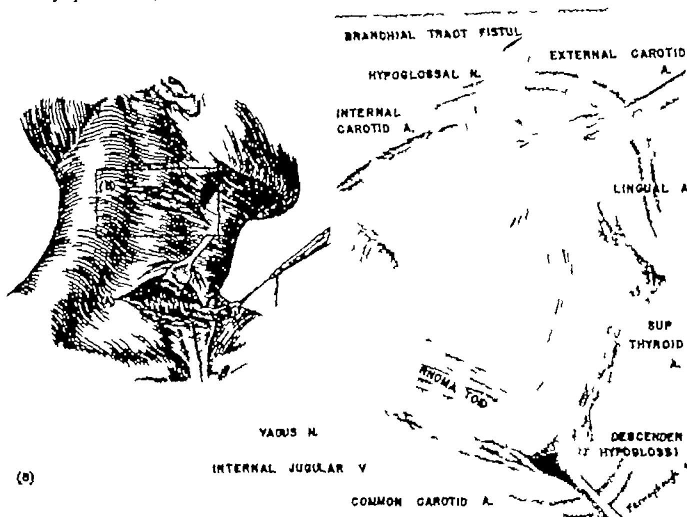


Fig. 492. Stepladder technic for removal of branchiogenic fistula. Insert shows elliptical incision over external opening of fistula (A) The fistula is dissected upward beneath the skin and superficial fascia as far as possible. A second incision is made over the fistulous tract. The fistulous tract is then followed, as demonstrated, to its opening in the pharynx. The fistulous tract is meticulously dissected out from the internal jugular vein internal and external carotid arteries, and hypoglossal nerve. (Figs. 491 492, and 493 Ward, Hendrick and Chambers, Courtesy Western Journal of Surgery Obst. and Gyn.)

cases. Often the fistulous tract is palpated along the anterior border of the sternomastoid muscle as a fibrous cord

TREATMENT

The extent of the fistulous tract is determined by injecting with a radio opaque substance preferably lipiodol (Fig 491), under local anesthesia injected around the external The orifice is closed with a purse string suture to prevent the escape of the lipiodol while x ray films are made.

Various treatments have been advocated for branchial fistulas. Cutler and Zollinger suggested the employment of a sclerosing solution Beck also used this method in treating fistulas in infants Several cases in this series had had injections of sclerosing solutions with

unsatisfactory results previous to their admission to the Johns Hopkins Hospital There is danger of marked inflammatory reaction and necrosis with perforation of the pharynx.

The most rational therapy is complete excision of the fistulous tract Various methods have been advocated Von Hacker suggests that a probe be inserted into the tract to facilitate its removal. Beck advocated a collar incision as for thyroid operations. Baumgartner stressed the importance of inverting the stump of the fistula into the cavity of the pharynx when complete fistulas were present

The procedure that was developed by Hamilton Bailey the so-called *stepladder* method of surgical excision is the most satisfactory It might be stressed here that we consider it unwise to inject the tract with any type of dye *such as methylene blue because of the disadvantage of soiling the operative fields with* the dye should the tract rupture

If the fistulous tract has been recently injected with lipiodol and the purse string stitch still remains, it should not be removed before an operation, as the distended tract is more easily palpable (Hamilton Bailey)

Technic of operation An elliptical transverse incision is made about the external orifice (Fig 492) The purse string suture around the orifice is caught in a hemostat and gentle traction applied to the fistula Any remaining solution that had been injected for x-ray visualization aids the dissection as it converts the tract into a small elongated cyst The tract is followed up beneath the skin, platysma muscle and fascia with dissecting scissors a second transverse incision is made over the tract at a higher level Then the tract is threaded through from the first to the second incision, and the dissection begun anew and thus continued until the sinus tract has been completely removed When the tract extends into the pharynx (Fig 493), an assistant's finger is placed in the mouth and pressure made over

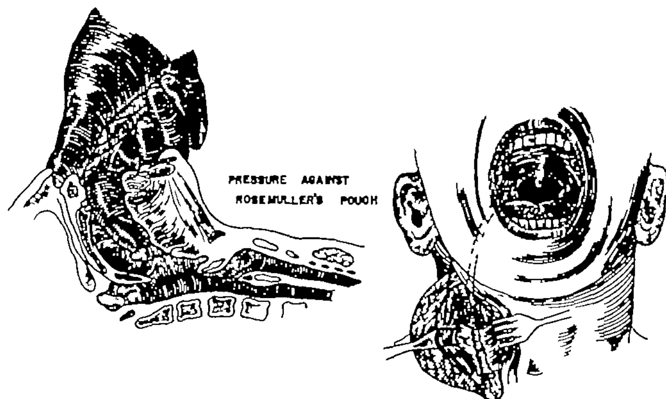


Fig. 493 Technic of excision of thyroglossal tract fistula continued

A. Assistant's finger placed in the mouth with pressure over the lateral pharyngeal wall, facilitates excision of fistulous tract

B Diagrammatic representation of tract extending from beneath the sternomastoid muscle into lateral pharyngeal wall.

the pharyngeal wall beside the tract to facilitate following the tract into the pharynx The tract is ligated with fine silk or fine catgut at its entrance into the pharynx. The wounds are closed in the usual manner with fine interrupted silk sutures A drain is placed in the lower wound to remain two or three days.

Since these fistulous tracts frequently occur in female patients or more fastidious male patients, the stepladder type of excision of the tract leaves smaller inconspicuous scars than those formerly used which left scars along the anterior border of the sternomastoid muscle extending from the lower neck to the angle of the jaw



Fig. 494 Branchiogenic cyst

A. Cyst present since ten years of age, gradually increasing in size tense, deeply attached.

B Photomicrograph showing cyst lined with squamous epithelium fibrous tissue in the wall also round cell infiltration and lymphoid tissue.

Branchiogenic Cysts

Branchiogenic cysts usually occur at the angle of the jaw but may be seen at any point from in front of the external auditory canal to the clavicle They may occur at any age the youngest in this group was five months and the oldest was seventy-one years They develop as a painless, at first inconspicuous, swelling along the anterior border of the sternomastoid muscle (Fig 494 A and B) Because it is painless it may be allowed to grow to a very large size At times these cysts develop following tonsillectomy as the postoperative scar closes a previously patent and unnoticed internal incomplete branchial fistula. From a globular mass in the upper anterior triangle of the neck just below the angle of the jaw they enlarge, become elongated as they follow the course of the sternomastoid muscle growing just under its anterior edge (Fig 495) They may bulge into the floor of the mouth at the base of the tongue, but seldom, if ever, bulge into the pharynx.

CLINICAL BEHAVIOR

It is not infrequent that the patient will give a history of the cyst developing following an upper respiratory infection or sore throat. It is likely that the infection only called the patient's attention to a pre-existing cyst. Low lying cysts that are not very tense may suggest lipoma

These cysts seldom suppurate spontaneously but infection may occur following incomplete

operation, upper respiratory infection repeated aspiration or the injudicious use of x ray therapy. They may develop epithelial malignancy. Repeated aspiration only invites infection does not in any way effect a cure of the cyst. Such an inflammation renders the cyst wall adherent to the surrounding structures. Non infected cysts have thin walls. Cysts may be considered precancerous or premalignant. Muscle fibers and fibrous tissue are also noted in the walls. The thickness of the walls depends upon previous inflammation or suppuration which will cause the cyst to adhere densely to the surrounding structure.

Aspiration of the cyst that previously had not been infected yields rather thick transparent mucoid and somewhat sticky fluid signifying as a rule, that columnar epithelium lines the cyst. However when an opaque watery or milky fluid is found the cyst will be lined with squamous epithelium. If both types of epithelium are present various consistencies between the two fluids are noted. Bailey feels that the finding of cholesterol crystals in aspirated material is diagnostic of branchial cyst.

There is a familial tendency to branchial cysts. Five cases in this group stated that one or more members of their family had a similar condition.

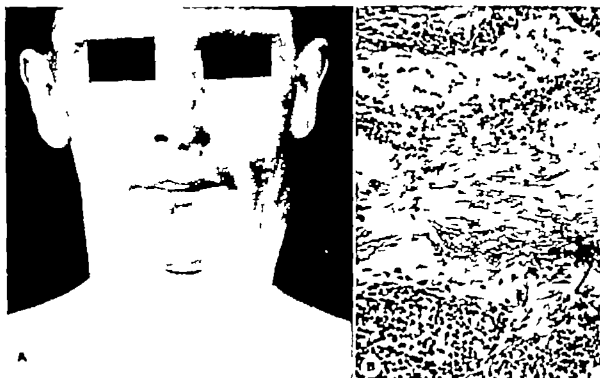


Fig. 495 Branchiogenic cyst, left side of neck.

A. Branchiogenic cyst present since three years of age lying deep to anterior border of sternomastoid muscle, causing it to bulge forward. When removed the cyst extended to the pharynx.

B. Photomicrograph of cyst wall showing squamous cell epithelial lining. Fibrous connective stroma infiltrated with round cells and areas of lymphoid tissue.

HISTOLOGY

The lining epithelium presents various patterns (Fig 496 A and B). Either squamous epithelium or stratified columnar epithelium may be observed over the entire wall or both types may be present together in the same cyst. Papillary projections are frequently noted and may be covered with either type of epithelium. The columnar epithelium may contain cilia. Well formed lymph structures including germinal centers are noted in the cyst wall. It is not uncommon for squamous epithelial lining to dip into the lymphoid tissue and show some degree of keratinization. Such

Bailey divides branchial cysts into four groups according to their anatomical location and relates the cyst to the surrounding structures. The first type lies at the anterior border of the sternomastoid muscle, does not extend deeply and is found just beneath the superficial cervical fascia The second type is beneath the superficial and the enveloping layers of the cervical fascia where pressure of the fascial planes causes the cyst to become oblong and along the great vessels where the cyst may be adherent to the carotid sheath The third type is deeper and frequently lies next to the lateral wall of the pharynx and may be found between the external and internal carotid artery A prolongation of the cyst may pass upward to the lateral area of the atlas, or to the base of the skull The fourth type contains mucous and lies entirely posterior to the common carotid artery next to the pharynx. As a rule this type is seldom observed clinically as it lies very deeply and produces no symptoms The first three types were the only ones encountered in our series

A few typical cases are given to illustrate symptoms. One male patient, aged 32, had a cyst on the left side of the neck which had been present for seven years. Pressure over the cyst caused it to empty its foul-smelling contents into the mouth nauseating the patient.



Fig. 496. Branchiogenic cyst, containing cylindroma in wall

A Cyst in right side of neck, 8 years duration, located under the anterior border of sternomastoid muscle causing muscle to bulge forward. Cyst began to grow during the past year

B Photomicrograph of cyst wall containing epithelial cells in nests, and showing palisading. Moderate amount of hyalinized connective tissue

A white male aged 38 was referred with a history of a cyst, measuring 4 x 5 cm., present for ten years and located on the right side of the neck at the angle of the jaw There was a gurgling sound when fluids were swallowed He was referred to the Johns Hopkins Hospital with a diagnosis of esophageal diverticulum

Another patient aged 32 had had a cyst on the right side of the neck for five years It measured 3 x 5 cm The patient was in excellent physical condition except that he stated that he had had repeated bouts of infection in the cyst for two or three years When the cyst was removed it contained in addition to the usual findings, tuberculous granulation tissue

Repeated aspirations the method advocated a number of years ago only invite infection One patient a white female aged 21 gave a history of having had a cyst since she was 11

years of age She had no trouble with it until she consulted her physician for its removal on cosmetic grounds. The cyst was aspirated eight times. Following the last aspiration it was injected apparently with some type of sclerosing solution It became infected and there was extensive inflammatory reaction of the cyst and surrounding structures When admitted to the hospital there were malaise, elevated temperature, leukocytosis, and weight loss of thirty five pounds. The cyst was excised The walls were adherent to the surrounding structures The symptoms disappeared immediately

The injudicious use of x ray is to be condemned Two patients one a baby 6 months of age, and the second a white male, aged 39 had x ray therapy over the cyst The former was wrongly diagnosed as Hodgkin's disease and the second as tuberculous lymphadenitis *No biopsy was taken in either case before x ray therapy* A violent reaction resulted which was very slow to recede At operation the walls of the cyst in each case were greatly thickened and adherent to the surrounding structures. Following careful surgical excision there was complete recovery

DIAGNOSIS

There is usually a history of painless swelling, slowly developing in the region of the angle of the jaw These cysts must be differentiated from *dermoid cysts* which often contain hair Dermoids are more superficial as a rule than branchial cysts and are not attached to the lateral pharyngeal wall. Frequently it is rather difficult to make a careful distinction between the two before operation but surgical removal is the treatment of choice in each case

Cystic hygroma of the neck presents a loculated soft cystic tumor most frequently encountered in early childhood They can usually be well transilluminated with light distinguishing them from branchial cysts

Broken-down tuberculous lymph nodes and chronic cervical adenitis frequently are confused with early small branchial cysts Tuberculous abscess, present for several years, is rather firmly attached to the skin and the surrounding structures. When each type of lesion is aspirated the contents may be quite similar on gross examination Cultured by the ordinary methods both may be found sterile. The finding of cholesterin crystals in the fluid removed from the cyst as enumerated above, is positive evidence of branchiogenic origin

Thyroglossal tract cysts are always in or near midline and usually attached to hyoid bone accounting for their change in position with deglutition.

Lipomas are frequently encountered in the neck They produce lobulated tumors that are not cystic and on aspiration no fluid is obtained

Cavernous hemangiomas are occasionally seen in the neck When deep-seated, they may be confused with a deep-seated branchial cyst Cavernous hemangiomas are usually of bluish color As a rule, careful palpation suggests the character of this condition by the "bag of worms" feeling of the tortuous enlarged veins of the hemangioma. Pressure forces blood out of the hemangioma, causing its collapse upon release the hemangioma refills.

Carotid body tumors occur at the bifurcation of the carotid vessels They are elastic in consistency and movable laterally but not vertically These tumors as a rule, transmit arterial pulsation on account of their location in the crotch of the common carotid artery

Primary lymphomas may be confusing This is especially true if there is a single enlarged lymph node. The lymphomas are rarely single, and often appear as a group of fused adherent nodes. Lymphomas are apt to be firmer than branchial cysts

Metastatic lesions are frequent in the neck. As a rule, more than one node is involved The tumor is hard and may be immobile early Even careful examination may not reveal the primary focus. In the event the primary focus is not found biopsy will establish the diagnosis.

Aberrant thyroid tumors are infrequently encountered. As a rule, they may be noted any place from the level of the hyoid bone to the suprasternal notch They may vary in size

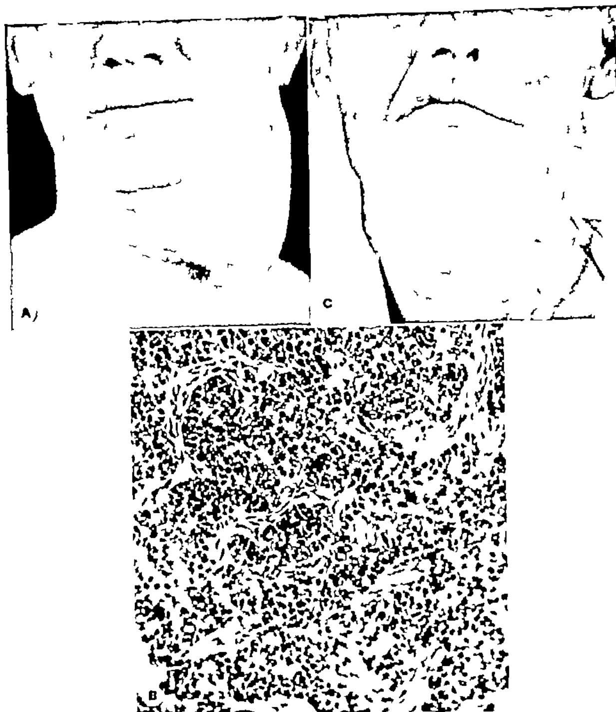


Fig 497 Branchiogenic cyst undergoing carcinomatous change

A Male 62 years of age with mass left side of neck 8 years' duration During the past year tumor has grown rapidly became very firm painful, disturbing respiration and deglutition. Areas of hardness in wall. (Courtesy of Western Jour Surg., Obst. and Gyn., Vol. 57 No 11)

B Photomicrograph of section of cyst wall showing infiltration with squamous epithelial cells, varying in size shape and chromaticity Moderate fibrous tissue stroma.

C Photograph following excision of cyst and radical neck dissection. Tumor had infiltrated lower half of parotid and extended to the lateral pharyngeal wall. Horner's syndrome. Paralysis of lip muscles due to injury to mandibular branch of facial nerve.

from 1 cm. to 4 or 5 cm in diameter In general they are firm mobile and are not cystic like branchiogenic cysts.

Neurofibromas are occasionally seen in the neck They may present a rather firm tumor that is immobile and varies in size from 1 cm to 3 or 4 cm in diameter Neurofibromas may or may not be multiple. The final arbitor of the diagnosis is always biopsy

TREATMENT

Treatment consists in complete extirpation of all epithelial-bearing tissue The use of scleros-

ing solutions repeated aspiration and x ray are mentioned only to be condemned strongly

It was mentioned previously that drainage of the cyst by surgical measures only creates a persistent sinus. Seventeen of the patients of this series gave a history of having a cyst drained one or more times. Four patients had excision attempted with a recurrence of the cyst within a period of one to two years, indicating incomplete removal

The best approach is through an incision centered over the most prominent part of the cyst and parallel to the anterior border of the sternomastoid muscle. Since there may be attachments to important nerve trunks and vessels, it is necessary to have adequate exposure to visualize the cyst by retracting the overlying structures Care should be exercised to prevent rupture of the cyst in the superior medial border the site of its deepest recesses Any epithelium left behind will give rise to recurrence The wound is closed in any manner convenient to the operator that will give the best cosmetic result A small drain is left in the wound for one or two days.

One case of this group had two cysts on the left side and one on the right On the left side one cyst was just below the angle of the jaw and the other was below the level of the hyoid bone. On the right side the single cyst was just below the angle of the jaw On each side, one cyst encompassed the carotid artery jugular vein, and vagus nerve This is mentioned to emphasize the magnitude of the operative procedure necessary to completely extirpate all epithelial-bearing tissue

Branchiogenic Carcinoma

This condition was first described by Von Volkman in 1882 who not knowing the etiology simply called it a tumor of the neck He could not ascribe the source to the pharynx, mouth, nose ears esophagus lymph nodes, or skin Lorenz in 1913 described malignant cervical tumors, which he called branchiogenic carcinoma and was of the opinion that they had their origin in aberrant branchial epithelial remains

There were seven cases of branchiogenic carcinoma in our group of seventy cases of branchial rest abnormalities. They as a group, occurred in the latter decades of life, the ages varying from thirty nine to seventy-one years. Six of the patients were over fifty years of age.

CLINICAL BEHAVIOR

The site of branchiogenic carcinoma is usually high in the neck, just below the angle of the jaw (middle location for branchiogenic anomalies) but it may occur any place where branchial rests are found, i.e., from the preauricular area to the clavicle. The symptoms vary according to the location of the tumor and the stage of the disease when the patient presents himself for examination (Fig 497 A B and C) Frequently the patient first notices a firm nodule located beneath the angle of the jaw in front of or beneath the sternomastoid muscle At first there is no pain but as the tumor grows an uneasy feeling is experienced on the affected side, the patient stating that he thrusts his chin forward to release tension on the tumor and relieve the unpleasant sensation As the tumor develops and the surrounding structures become involved intermittent pain and later constant pain ensue. As the cervical or brachial plexus becomes involved neuritic symptoms occur (Fig 498 A and B) When the cervical sympathetic plexus becomes involved, Horner's syndrome may be present Later the pain becomes constant and there is disturbance of deglutition and respiratory difficulty In the event the tumors are close to the clavicle, vascular disturbances of the upper extremity on the same side may become apparent. This was noted in a sixty-seven year old white male, having a lesion in the lower third of the neck of one month s duration. The hand and arm were cold and swollen with reduced volume of the radial pulse. He also had more pain than is usually present in a branchiogenic cyst At operation, a large cyst was removed In one area of the wall, the operator noted marked thickness, which on frozen section revealed epithelial malignancy perforating the cyst wall and invading the sur

rounding structures A radical dissection of the neck was done with the result that the patient was alive and well with no recurrence ten years later

Branchial carcinomas vary in size As a rule they average 3 or 4 cm in diameter and are of firm consistency unless they develop in a cyst wall The tumor may become soft when degeneration and liquefaction in some of the areas has occurred They as a rule are not fixed to the skin unless the capsule has been penetrated by the neoplasm and the skin invaded

Three cases in this series two other than the one enumerated in a previous paragraph apparently had their origin in cysts. One was a male aged fifty two, with a cyst in the left side of the neck which was excised in the Johns Hopkins Hospital fourteen years previously He was entirely symptom-free until eleven years later when he developed a rapidly growing firm tumor in the old operative site At operation, branchiogenic carcinoma, with metastasis to the regional lymph nodes, was present A third patient a male fifty seven years of age had a cyst for seven years. It was removed by surgical excision. The operative note mentioned a fistulous tract extending to the region of the facial nerve The fistulous tract was not completely excised because the operator was afraid of injury to the facial nerve. Thirteen years later he developed a firm, rapidly growing tumor in the upper end of the operative site A markedly undifferentiated squamous carcinoma was found at operation A radical neck dissection was done, followed by x ray therapy However the patient died of pulmonary metastasis one year later



Fig 498. Branchiogenic carcinoma

A. Branchiogenic carcinoma developing in 66-year-old male began with nodular growth lateral cervical area, one year ago. Ulceration over anterior surface. Severe pain, due to involvement of cervical nerves. Skin reaction following irradiation. (Courtesy Western Jour Surg., Obst. and Gyn., Vol. 57 No 11)

B Photomicrograph of tumor showing infiltration with epithelial cells in sheets, nests cells vary in size and chromaticity Connective tissue edematous.

A cylindroma was encountered in one patient a white female thirty-seven years of age who had a branchiogenic cyst for a period of one year A globular tumor 3.5 cm. in diameter at the angle of the jaw was excised The cylindroma was noted in an area of the wall that was thickened This patient was alive and well ten years later

PATHOLOGY

Branchiogenic carcinoma, as a group presents the characteristic picture of squamous cell carcinoma In the event the tumor develops

of the midline any place between the foramen cecum at the base of the tongue and the supra sternal notch. A drawing (Fig 499) illustrates where these lesions have occurred in this group intratongue (4) (Fig 500) submental region (12) suprahyoid (1) (Fig 501), at the level of the hyoid (12), infrahyoid (52) suprasternal (13) in the midline (76) to the right of the midline (13) and to the left of the midline (12) The importance of the latter two locations is that they may be confused with other lesions, for it is generally taught that these abnormalities *occur exactly in the midline*



Fig. 500 Thyroglossal tract cyst in substance of tongue bulging beneath mandible. Cyst contained in its wall all thyroid tissue present in body (Case of Dr Samuel Crowe) (Figs. 500 502 504–507 used through the courtesy of Surg., Gyn & Obs., Vol 89 No. 6 December 1949.)

These lesions are of importance because they may be the seat of recurring inflammatory disease and produce disfigurements Fifty two of the 105 cases gave a history of recurrent infection, extensive enough in fifteen to produce spontaneous rupture of the cyst Marked infection was present in the ten cases admitted to the hospital and extensive cellulitis was present in three producing what is commonly termed bull neck. The cyst was lanced and drained because of infection in six cases after admission to the hospital All of these patients later had a radical surgical procedure with complete elimination of the epithelial tract

The cyst may vary in size from a small pea to as large as a golf ball the average size being *2 or 3 cm* in diameter When a cyst *is located in the substance of the tongue or suprahyoid* area its presence may be most annoying This was exemplified in a male patient aged eighteen, of one of the authors (J W H) The patient would be disturbed while eating or talking by a choking sensation and swelling of his tongue A swelling developed in the submental area He observed that by making pressure over this tumor his mouth would fill with a mucoid fluid with immediate relief of symptoms. Frequently as cysts occurring in the substance of the tongue, in the submental or suprahyoid area,



Fig 501 4-year-old white female thyroglossal tract cyst, present since immediately after birth. Suprahyoid area

become larger the patients notice tenseness in the tissues and develop mild choking attacks.

The contents of the cyst is of mucoid nature unless infection has taken place when it becomes purulent Frequently following infection there is rapid increase in the size of the cyst its walls become thickened and it is tender and painful

When infection leads to suppuration with spontaneous rupture or when incision and drainage is required a sinus tract results Incision and drainage is not advised except to relieve acute infection as a temporary measure *To incise a non infected cyst is an act of great* discredit to the *medical profession for no per*

manent good is accomplished and a persistent draining sinus remains to become infected repeatedly (Fig 502) Recurrent infection causes marked scarring increasing the difficulty of subsequent operative removal.

HISTOLOGY

Thyroglossal tract cyst or fistula is lined by stratified squamous columnar or transitional epithelium. After infection, a heavy layer of fibrous connective tissue surrounds the tract Lymphoid tissue, as seen in branchial cleft cysts and fistulas, is not observed in thyro-



Fig. 502. Thyroglossal tract sinus below hyoid bone and in suprasternal notch Repeated incisions and drainage of the cyst for a period of twenty years.

glossal tract abnormalities. It has been reported that malignancy may develop in the cyst wall or in the sinus or fistulous tract This was not observed in any of these cases, nor in a series reported by one of the authors (JWH)

Thyroid tissue was found in one of our cases A fourteen year-old male had a cyst measuring about 4 x 4 cm in the substance of the tongue for eleven years previous to admission to the hospital Four or five months following excision he developed symptoms of hypothyroidism, almost to the stage of cretinism. Histological study revealed thyroid tissue in the wall of the cyst There was no palpable thyroid gland in the neck Evidently all the thyroid in the body was contained in the cyst The patient was followed for a period of over eleven years during which time it was necessary for him to continue taking thyroid extract. At the present time he is about to complete his college education and is normal in every respect (Patient of Samuel Crowe, Fig 500)

In this group of 105 cases, a cyst (Fig 503) was present in sixty two (or 59 per cent), a sinus tract in thirty-six (or 34 per cent) The latter term designates the discharging sinus resulting from a cyst which was lanced previously or had become infected and suppurated This is differentiated from twenty cases (19 per cent) in which the patient had a congenital fistula A definite cord of tissue could be palpated under



Fig. 503 Thyroglossal tract cyst, infrahyoid area. Treated for goiter with iodine over a period of several years.

the skin and there was no evidence of a cyst being present

DIAGNOSIS

In making the diagnosis of a thyroglossal duct cyst or fistula it is to be remembered that the cyst or fistula occurs in or near the midline any place from the foramen cecum at the base of the tongue to the suprasternal notch and that these abnormalities are the most frequent pathological lesions situated in this region. Occasionally as mentioned above they may occur just to the right or the left of the midline but not far enough to cause any difficulty in a differential diagnosis The cyst is smooth ovoid or round and translucent when examined with transmitted light It is to be differentiated from dermoid lipoma sebaceous

cyst cysts of the pyramidal lobe of the thyroid gland, enlarged lymphatic nodes of the cricothyroid membrane and pathologically enlarged midline submental lymph nodes The cyst moves vertically with deglutition

Thyroglossal fistula or sinus tract should not be confused with any other sinus tract The opening of a branchial fistula or sinus tract is on the side of the neck as emphasized above. The fistulous tract may communicate with oral cavity at the base of the tongue which was noted in two of our cases. Branchial fistulae communicate with the pharynx opening in

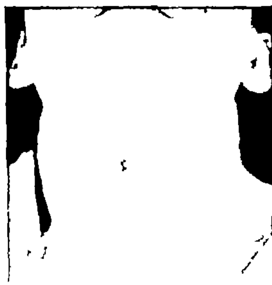


Fig. 504 Extensive scar resulting from injudicious and repeated x ray and radium therapy for thyroglossal cyst

Rosenmüller's pouch If there is any doubt about the fistula or sinus tract opening into the mouth or pharynx it may be injected with lipiodol and x ray films made Such a procedure is very painful to the patient and should not be done unless absolutely necessary However if it is desired to inject the fistulous tract with lipiodol for diagnosis, the external opening may be injected with local anesthesia. With a small catheter or lacrimal duct syringe, 2 or 3 cc of warm lipiodol are then injected into the tract

While observing cases of thyroglossal tract abnormalities for several years it was noted that some were very superficially located while others were deeper This fact was confirmed by operation. Some were found just beneath the skin platysma muscle, and superficial fascia, others were beneath the enveloping layer of the cervical fascia (fascia Colli) while an occasional one was under the pretrachial fascia It was demonstrated by H O Knight and has been reported previously by J W H as shown in Figure 499 that the enveloping layer of fascia is attached to the anterior surface of the hyoid bone whereas, the pretracheal layer of fascia is attached to the posterior surface of the hyoid bone. It may be surmised that during embryological development if the thyroglossal duct is anterior to the hyoid bone the cyst or fistula will be found just under the skin platysma muscle and superficial fascia if the duct passes through the hyoid bone the cyst or tract will be found between the enveloping layer and the pretracheal fascia If on the other hand during development the duct passes posterior to the hyoid, the cyst or fistula will lie deep to the pretracheal fascia

TREATMENT

Treatment of thyroglossal duct abnormalities is surgical excision of all epithelial tissue. It should be stressed again that lancing the cyst unless it is infected and shows evidence of suppuration, is a discredit to the medical profession This procedure serves no useful purpose and only creates a persistent draining sinus that is constantly discharging mucous and is more likely to become infected than otherwise.

The injection of sclerosing solutions is mentioned only to be condemned It is unreasonable to suppose that an injected sclerosing solution could reach all of the epithelial-lined side pockets that are frequently present Irradiation is also contraindicated One case of this series was treated with radiation with resultant destruction of so much skin that multiple plastic procedures were necessary to close the defect (Fig 504)

Any operation for this condition will be unsuccessful unless the entire epithelial lining of cyst sinus or fistula is completely excised Forty three patients of this group had a history

of one or more surgical procedures previous to admission to the Johns Hopkins Hospital. Twenty-one gave a history of having a cyst lanced and twenty two gave a history of having the abnormality excised It is our opinion that failures are due to the inexperienced operator s lack of appreciation of the necessity of removing all of the tract up to the foramen cecum at the base of the tongue This radical

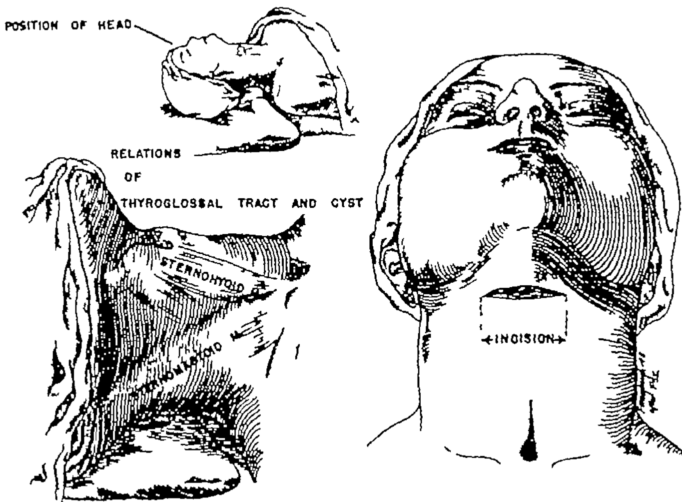


Fig 505 Illustration of position of head type of incision for removal of thyroglossal tract cysts and fistulas in the upper neck. Similar type of incision is used for thyroglossal tract abnormalities in the lower part of the neck.

excision requires removal of the central part of the hyoid bone when the tract or cyst lies below the hyoid together with a block of tissue well around the sinus or fistulous tract up to the base of the tongue When the tract or cyst is all above the hyoid bone the hyoid is untouched and the resection carried out above it in the base of the tongue The extensive surgical procedure does not appreciably increase the length of time for the operation nor increase the danger Midline vertical incisions are contraindicated as they do not give sufficient exposure and leave an unsightly scar causing a midline contraction which is almost impossible to eradicate

The operative procedure proposed by Sistrunk in 1920 for the radical removal of thyroglossal duct abnormalities has proved most efficacious When his technic is carefully followed there will be a minimal number of recurrences. A transverse incision 5 or 8 cm in length is made over the cyst or an elliptical transverse incision (Fig 505) is made around the sinus tract opening The skin subcutaneous tissue and platysma muscle are reflected We think that it is not worthwhile to inject a sinus tract with methylene blue or other dye to out

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erving cases of thyroglossal tract s for several years it was noted re very superficially located while deeper This fact was confirmed by operation Some were found just beneath the skin, platysma muscle and superficial fascia others were beneath the enveloping layer of the cervical fascia (fascia Colli) while an occasional one was under the pretrachial fascia It was demonstrated by H O Knight and has been reported previously by J W H as shown in Figure 499 that the enveloping layer of fascia is attached to the anterior surface of the hyoid bone whereas, the pretracheal layer of fascia is attached to the posterior surface of the hyoid bone It may be surmised that during embryological development if the thyroglossal duct is anterior to the hyoid bone the cyst or fistula will be found just under the skin, platysma muscle, and superficial fascia if the duct passes through the hyoid bone the cyst or tract will be found between the enveloping layer and the pretracheal fascia if on the other hand during development the duct passes posterior to the hyoid the cyst or fistula will lie deep to the pretracheal fascia

TREATMENT

Treatment of thyroglossal duct abnormalities is surgical excision of all epithelial tissue It should be stressed again that lancing the cyst unless it is infected and shows evidence of suppuration is a discredit to the medical profession This procedure serves no useful purpose and only creates a persistent draining sinus that is constantly discharging mucous and is more likely to become infected than otherwise

The injection of sclerosing solutions is mentioned only to be condemned It is unreasonable to suppose that an injected sclerosing solution could reach all of the epithelial-lined side pockets that are frequently present Irradiation is also contraindicated One case of this series was treated with radiation with resultant destruction of so much skin that multiple plastic procedures were necessary to close the defect (Fig 504)

Any operation for this condition will be unsuccessful *unless the entire epithelial lining of* cyst sinus, or fistula is completely excised. Forty three patients of this group had a history

of one or more surgical procedures previous to admission to the Johns Hopkins Hospital. Twenty-one gave a history of having a cyst lanced and twenty two gave a history of having the abnormality excised It is our opinion that failures are due to the inexperienced operator's lack of appreciation of the necessity of removing all of the tract up to the foramen cecum at the base of the tongue. This radical length of time for the operation, nor increase the danger Midline vertical incisions are contraindicated, as they do not give sufficient exposure and leave an unsightly scar, causing a midline contraction which is almost impossible to eradicate

The operative procedure proposed by Sistrunk in 1920 for the radical removal of thyroglossal duct abnormalities has proved most

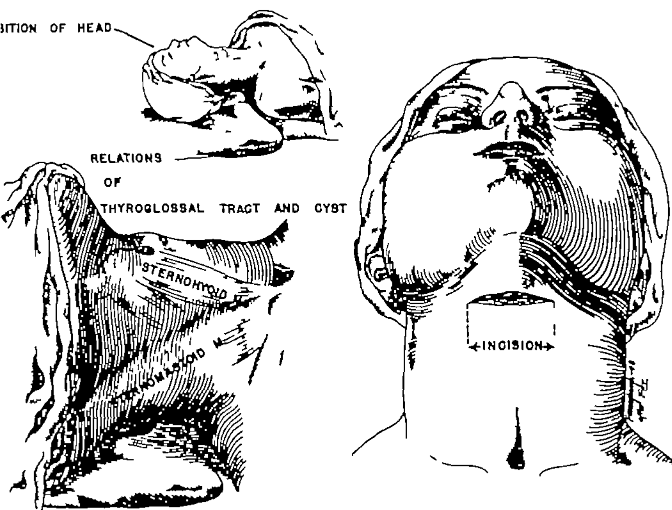


Fig. 505 Illustration of position of head type of incision for removal of thyroglossal tract cysts and fistulas in the upper neck. Similar type of incision is used for thyroglossal tract abnormalities in the lower part of the neck

excision requires removal of the central part of the hyoid bone when the tract or cyst lies below the hyoid together with a block of tissue well around the sinus or fistulous tract up to the base of the tongue When the tract or cyst is all above the hyoid bone the hyoid is untouched and the resection carried out above it in the base of the tongue. The extensive surgical procedure does not appreciably increase the efficacious When his technic is carefully followed there will be a minimal number of recurrences A transverse incision 5 or 8 cm in length is made over the cyst or an elliptical transverse incision (Fig 505) is made around the sinus tract opening The skin subcutaneous tissue, and platysma muscle are reflected We think that it is not worthwhile to inject a sinus tract with methylene blue or other dye to out

line its course, as the dye frequently spills and stains the other tissues obscuring the operative field. A definite fibrous tract can be followed sufficiently well without the aid of one of the dyes The cyst or fistulous tract is followed to the level of the hyoid bone which is readily palpated at the junction of the sterno-hyoid muscles. As the relation of the fistulous tract is anterior to or through or occasionally four years of age, or cut with bone cutters in older patients. Traction on the fistulous tract or cyst, or on the hyoid itself will pull forward the freed central portion of the hyoid bone Frequently the tract above the hyoid bone is small and pliable requiring care to prevent its being broken off By having the anesthetist or an assistant put a finger in the mouth and making pressure over the base of tongue, the

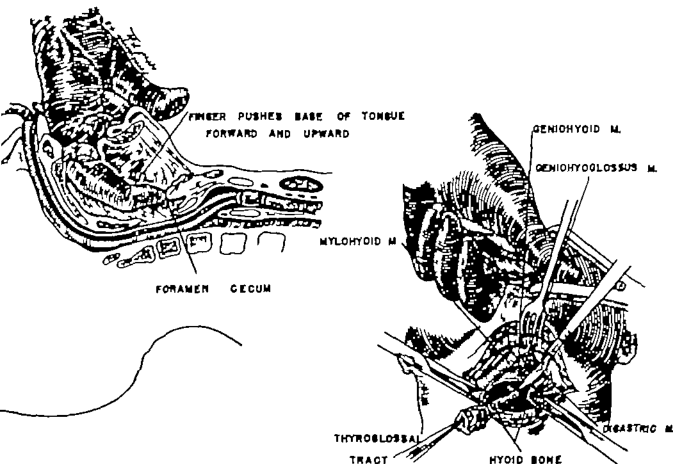


Fig. 506. Endotracheal tube in place Assistant s finger placed in the mouth forcing base of tongue and foramen cecum forward, facilitating coring out stalk of tract The fistulous tract is being followed to the foramen cecum after a section of the hyoid bone is removed (Modified and redrawn from Sistrunk Surg Gyn. and Obst.)

posterior to the hyoid bone, it is necessary to remove the central portion of the hyoid bone in order to insure complete removal of the tract to facilitate exposure above this point (Fig 506) To facilitate this removal the hyoid bone is grasped with Allis forceps just to one side of the midline and pulled forward Muscle attachments are freed for 1 cm on each side of the center About 1 cm. of the center is re moved with scissors in patients under three or tongue is forced forward making it easier to take a core of tissue including the muscles around the stalk of the tract down to the foramen cecum. The inexperienced operator may hesitate to follow this procedure for fear of entering the mouth or pharynx As a matter of fact the pharynx is frequently entered as the foramen cecum is excised. A purse-string suture of fine chromic catgut on a small round needle will close the defect by inverting the local tissue

into the pharynx. The musculature of the tongue is brought together (Fig 507) in the midline with interrupted sutures of fine silk or fine chromic catgut. The severed edges of the hyoid bone are brought together with catgut sutures through the bone in children or through the periosteum or adjacent fascia in adults. Even if the ends of the bone are not approximated there will be no derangement in the action of the local muscles. A small rubber tube drain is placed deep in the muscles of the tongue and brought over the sutured hyoid bone and through the wound The skin is closed in layers with sutures of fine silk. The skin stitches are removed after four or five days, resulting in a hairline scar, practically invisible after a few months

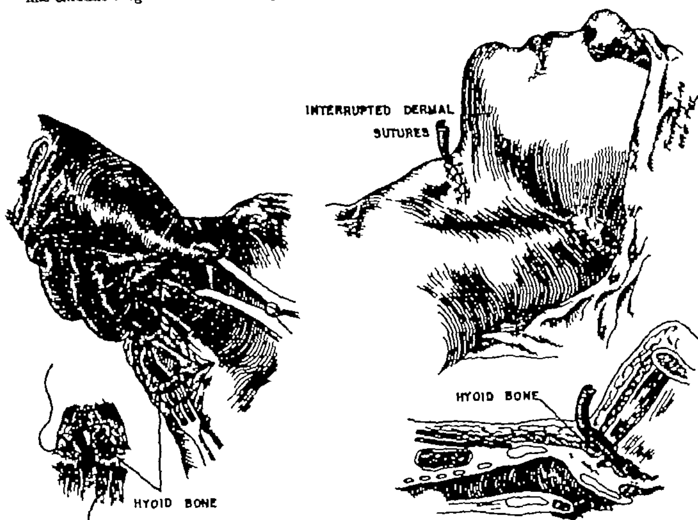


Fig 507 Technic of suturing hyoid bone and closure of wound. Drain inserted. (Redrawn from Sistrunk, Surg Gyn. and Obst.)

TABLE 38

Summary of Treatment of 105 Cases of Thyroglossal Tract Abnormalities

(Cysts and fistulas)

Suprahyoid	28
No bone removed	no recurrences
Level or below hyoid	77
Bone removed	34 (2 recurrences—6%)
Bone not removed	43 (11 recurrences—25 6%)

When this technic is followed recurrences will be reduced to a minimum (Table 38)

There were four intratongue lesions in this series, all of which were removed intraorally by the following technic, none recurred

The technic of removing either intraoral thyroglossal rests or aberrant thyroid tissue in the region of the foramen cecum or in the substance of the tongue follows

Intratracheal anesthesia is the anesthetic of choice with the anesthetic tube passed

through the nose The pharynx is packed off well with gauze. The head of the operating table is lowered 10–15 degrees. The tongue is brought forward with a towel clamp or suture

An elliptical incision is made around the tumor in the long axis of the tongue, preferably with an electrosurgical cutting current to lessen bleeding Large vessels are clamped and coagulated The tumor is completely excised with its capsule The incision in the tongue is closed with interrupted mattress sutures of fine chromic catgut

TUMORS OF THE CAROTID BODY

Carotid body tumors are infrequently encountered They may simulate other tumors found in the carotid triangle in that their growth is slow persistent, and may undergo malignant change and jeopardize the life of the patient

The first mention of the carotid body was by Von Haller in 1743 who applied the name of *ganglion minutum* In 1862 Luschka gave a more detailed description of the microscopical structure and the location of the body in the carotid crotch and called it the *ganglion intercaroticum* It was Luschka's opinion that the carotid body was part of the sympathetic chain. In 1891 Marchand reported the removal of a carotid body tumor following the ligation of the jugular vein and common carotid artery the hypoglossal, sympathetic and vagus nerve were also removed. The patient expired on the third postoperative day Gersuny and Madyl each reported the removal of a carotid body tumor with the recovery of their patients. The common, internal and external carotid arteries were ligated in each case however Madyl's patient developed hemiplegia, facial paralysis, and aphasia but recovered after a considerable period of time The first American surgeon to report the successful removal of a carotid body tumor with verified histological examination was L. C Scudder who also brought the literature up to date (1903)

Numerous case reports and reviews of literature have appeared by Payne Funk Phelps and Case and Snyder Bevan and McCarthy Gratiot Rankin and Wellbrock, and Lewison and Weinberg.

The Carotid Body

GROSS ANATOMY OF THE CAROTID BODY

Carotid bodies occur bilaterally and are situated in or near the crotch of the common carotid artery The average carotid body is 6 x 4 x 2 mm. in size is brown reddish-brown, or gray or a variation of a mixture of these colors The carotid body is rather firmly attached to the carotid bifurcation by a fibrous connective tissue band. It is ovoid in shape, and is contained in a fibrous capsule which sends fibrosepta into the parenchyma, dividing it into lobules. The nutrient vessel usually is a small twig from the internal, external, or common carotid arteries.

The nerve supply is from the numerous nerves in its vicinity the vagus, hypoglossal sympathetic ganglia, and a branch from the glossopharyngeal Atrophy is noted in the carotid bodies of elderly individuals.

HISTOLOGY OF THE CAROTID BODY

The parenchyma is composed of rather large polyhedral or cuboidal cells with pale-staining cytoplasm. They may occur in sheets, strands, or alveoli The cytoplasm is finely granular and in the fresh specimen the granules are chrom positive The nuclei are small eccentrically placed and hyperchromatic A rich network of vessels and nerves are observed to ramify throughout the fibrosepta. Occasionally groups of ganglion cells are encountered These, with some of the cellular elements, exhibit an affinity for the chromatic salts, suggesting the relationship to the chromaffin system

PHYSIOLOGY OF THE CAROTID BODY

The physiology of the carotid body is not well understood There is no evidence to substantiate any relationship with the glands of internal secretion as formerly held by early investigators Their assumptions were based on the presence of chromaffin granules which were thought to secrete adrenalin or adrenalin

precursor It was also thought by some that the carotid body was associated in function with the carotid sinus and that it was a sensory organ containing chemoreceptors, whose function was thought to respond to chemical changes and oxygen tension in the blood, producing changes in respiration Later investigation showed that the carotid body is in no way associated with the carotid sinus mechanism in controlling blood pressure and chemical changes in the blood The fact that occasionally there is absence of carotid bodies in the human being and that both carotid bodies, when involved by tumors, may be removed without producing deleterious effects on the patient leads to the assumption that its function can be dispensed with without altering the physiology of the patient Carotid body tumors, either single or bilateral, do not produce symptoms referrable to an abnormal function of the carotid sinus such as dizziness fainting convulsive seizures, etc.

Tumors of the Carotid Body

PATHOLOGY

The only pathological lesion of the carotid body is tumor Such tumors are ovoid or spheroid in shape containing a definite fibrous capsule which binds them rather firmly to the carotid vessels They occur as reddish brown lobulated masses, varying in size from 2–10 cm. in diameter They have been classified as neuroblastomas, endotheliomas, paragangliomas, adenomas peritheliomas, and as simple carotid body tumors.

Malignant transformation is supposed to occur in 40–50 per cent of the cases (Harrington, Clagett and Dockerty) Frequently as in other tumors, it is difficult to distinguish between benign and malignant neoplasms of the carotid body When there is variation in the shape, size, and staining characteristics of the individual cells mitosis, evidence of invasion of the capsule and contiguous structures, malignancy is evident Local metastasis is frequently encountered and occasionally distant metastasis occurs.

HISTOLOGY

Microscopically two rather characteristic histological patterns, alone or mixed, have been described by Harrington Clagett, and Dockerty They designated one pattern as alveolar or insular, the other as peritheliomatous, the latter slightly predominating The alveolar pattern is illustrated by large islands of polyhedral cells that appear to be separated by narrow bands of connective tissue (Fig 508)



Fig. 508. Photomicrograph showing alveolar pattern carotid body tumor Large polyhedral cells with clear staining colloid forming acini Cells contain small hyperchromatic nuclei. Very little connective tissue stroma. Numerous vascular sinuses throughout connective tissue.

without much hyalinization The fibrous tissue in this type is permeated (Fig 509) by large, thin vascular sinuses. Endothelial cells seem to insinuate themselves between the alveolar cells and the wall of the blood sinuses Old blood pigment is distributed throughout the stroma in some tumors In this type the parenchymatous tissue cells occupy more than 95 per cent of the microscopical field (Fig 510)

In the second variety having the peritheliomatous pattern the cellular units are smaller



Fig. 509 Photomicrograph showing alveolar pattern type carotid body tumor Large polyhedral type cells with varying cytoplasm. Numerous capillary sinuses pervade connective tissue stroma. Multiple mitoses present



Fig 510 Photomicrograph showing both perithelimatous and alveolar pattern carotid body tumor Both large and small cells present Some forming acini others *occurring in small sheets Some cells have oblong nuclei* The alveolar units are separated by fibrous connective tissue containing capillary spaces. Blood pigment is present throughout the section.

irregular and some tend to form alveolar structures However the more usual picture (Fig 511) is that of small clumps of cells arranged in sheets, strands, and nests, separated from one another by vascular connective tissue. Hyalinization of the connective tissue is the prominent feature Also blood sinuses are abundant. The above authors commented that hyalinization of the fibrous connective tissue in some areas is so pronounced that the tumor resembles a mixed tumor of the salivary glands.



Fig 511 Photomicrograph of carotid body tumor with perithelioma tous pattern. Nests of polyhedral and cuboidal cells with some tendency to alveolar formations Cells contain small round and oblong nuclei that are hyperchromatic Numerous capillary sinuses present. Hyalinization of connective tissue in some areas

The predominant cell in each type is mainly polyhedral with a large amount of eosinophilic cytoplasm containing numerous vacuoles and granules and one or more hyperchromatic nuclei Multinucleated and uninucleated giant cells are frequently observed when malignancy supervenes

CLINICAL BEHAVIOR

These *tumors* occur in the carotid triangle of the neck either unilaterally or occasionally bilaterally They do not move with deglutition

The tumor is smooth or occasionally nodular, if of long standing It is not expansive but seems to move with the pulsating vessels with which it is so closely associated. It is movable laterally, but not vertically and when caught between the fingers, the pulsations of the associated vessels are readily perceived Their location is just under the anterior border of the sternomastoid muscle at the approximate level of the hyoid bone. The tumors are deep-seated and not attached to the skin Growth is slow but persistent, and since there are practically no early subjective symptoms other than the tumor medical consultation is requested only after many years.

Occasionally carotid body tumors may be confused with an aneurysm of the carotid artery by the expansile pulsations and thrill. Pressure over the carotid artery below the tumor will abolish the pulsation and thrill of an aneurysm Symptoms, as episodes of fainting hoarseness, dyspnea coughing, headache, and dysphagia, are indicative of pressure on, or invasion of structures in the immediate region i e, the recurrent laryngeal sympathetic, vagus, and glossopharyngeal nerves, and pharynx If malignant change with invasion of the contiguous structures is present cervical sympathetic nerves may be involved resulting in Horner's syndrome unilateral enophthalmus, ptosis and contracted pupil on affected side When there is local malignant involvement of the contiguous structures, the cervical and occipital nerves may also be involved, giving pain referable to the distribution of the cervical plexus. Pain referred to the region of the ear is also not uncommon in the larger tumors even if malignancy is not present

The following case histories are instructive

Case I The patient, a white male forty four years of age, gave a history of a tumor in the anterior cervical triangle of the left neck that was present for twelve years. The tumor increased remarkably in size during the past six months and there was some difficulty in swallowing solid foods. It was ovoid in shape and measured 8 cm in diameter and was movable from side to side but not up and down. The patient complained of pain in the left side of the neck radiating to the left ear The tumor was deeply seated under the anterior border of the sternomastoid muscle. A carotid body tumor was suspected. The patient, consequently was prepared one month by having his wife compress the common carotid artery against the sixth cervical vertebra four times daily at first for only a few moments increasing the time daily until the common carotid was compressed ten minutes each time with no evidence of fainting. At operation a reddish vascular tumor completely encircled the common and the internal and external carotid arteries. The hypoglossal nerve was dissected from the top of the tumor Complete excision of the tumor required ligation and removal of a section of carotid vessels and jugular vein. Aphasia was present for a few months after operation with eventual complete recovery The patient was well seven years later with no recurrence. The tumor was of the alveolar cell pattern type.

Case II The patient a white male thirty-eight years of age, was seen with a tumor in the left anterior cervical triangle, present for fourteen years. There were no symptoms other than the tumor and the patient stated it caused difficulty in shaving The tumor was 6 cm. in diameter produced a diffuse bulging under the anterior surface of the sternomastoid muscle. There was a distinct pulsation and bruit over the tumor The patient's family physician made the clinical diagnosis of aneurysm involving the carotid artery The tumor could be moved from side to side, but not vertically Pressure over the carotid artery eliminated the pulsation and bruit. The diagnosis of a probable carotid body tumor was made. The patient was prepared by having compression made over the carotid artery five or six times a day at first for a half minute increasing to ten minutes each time. At the end of a month a reddish-brown tumor in the crotch of the carotid artery was removed. A rubber-shod artery clamp was placed on the carotid artery well below the tumor which facilitated the dissection of the tumor from the internal external, and common carotid arteries. Histological examination revealed a tumor of the peritheliomatous cell pattern There was moderate hyalinization of the connective tissue. The convalescence was *uneventful* with no return of the tumor when the patient was seen *four years* later

DIFFERENTIAL DIAGNOSIS

A carotid body neoplasm should be suspected when any symptomless deep-seated ovoid tumor is located in the upper anterior cervical triangle with a history of slow growth for several years

Carotid body tumors are to be differentiated from metastatic lesions from above or below the clavicle Metastatic tumors are irregular, nodular and have a stony-hardness, with a

history of rapid growth They may be multiple

Branchial cleft cysts may occur in this locality but more frequently are encountered below the level of the division of the common carotid artery Both branchial cysts and *sinuses are more frequently superficial in their* location Also there is a history of slow growth extending in many cases from childhood Branchiogenic carcinoma arising either from a branchiogenic cyst or primarily may be confused with tumors of the carotid body Their consistency is firm to hard They are more frequently encountered in an older age group. Branchiogenic carcinoma does not have associated pulsation or thrill They are immobile in every direction

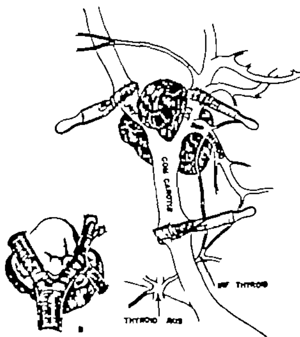


Fig 512. A. Carotid body tumor crotch of common carotid artery and extending around the internal and external carotid arteries Rubber-shod bulldog clamps applied to common carotid artery and the internal and external branches, which facilitates removal of the tumor without injury to the vessel walls B Cross-section of common carotid artery and its branches, showing the tumor has not invaded the vessel walls.

Aberrant thyroid tissue tumors, arising from the ultimobranchial bodies may be noted in front of the sternomastoid muscle or along the *course of the internal jugular vein They occur* as single or multiple tumors and are deep-seated and may simulate tumors of the carotid body in many details, as revealed in the following case history

The patient, a female aged forty two when twenty years of age had a tumor removed from the right side of the neck by the late Dr George Crile, with a diagnosis of aberrant thyroid tissue undergoing malignant transformation. A radical neck dissection was performed by Dr Crile. When examined by J W H. at the age of forty-four the patient gave a history of an ovoid tumor in the anterior cervical triangle on the left side of the neck for eight years. The tumor measured 4 x 4 cm and was deeply located under the anterior border of the sternomastoid muscle. There were no symptoms other than the presence of the tumor No pulsations or thrills were present. With the previous history of aberrant thyroid tissue, it was thought this tumor also represented the same type of tissue on the opposite side. At operation a tumor that measured 3 cm in diameter was found in the crotch of the carotid artery It was reddish brown in color and rather vascular A rubber-shod bulldog clamp (Fig 512) was placed on the common carotid artery below its bifurcation. The tumor was dissected away from the vessels with ease. Histological examination revealed it to be a carotid body tumor of the alveolar pattern type. The convalescence was uneventful and the patient was well ten years later

Neurofibromas may occur in the cervical region, as well as in other parts of the body As they develop from nerve tissue they are more frequently laterally located and deep-seated but have few features in common with carotid *body tumors.*

Primary lymphoma may occur as a discrete node, either superficially or deeply in the cervical region. More frequently they give a history of rapid development Other nodes appear sooner or later elsewhere in the body

TREATMENT

In selecting the appropriate treatment for carotid body tumors, it is necessary to evaluate the danger of leaving the tumor the cosmetic appearance of continued growth and the danger of the therapy suggested There is a tendency for carotid body tumors to grow slowly but persistently and from the study of reported series of cases, their most potential danger is *malignant transformation which is reported to* occur in from 35–50 per cent When malignancy does ensue it involves the contiguous struc

tures and develops local node metastasis Seldom, distant metastases have been observed As the tumor enlarges, there may be pressure on the pharynx, which interferes with swallowing or pressure on the surrounding tissues recurrent laryngeal hypoglossal, glossopharyngeal, cervical, sympathetic, and vagus nerves.

The only sure method of making a preoperative diagnosis is aspiration biopsy which is not to be recommended because of the danger of serious hemorrhage from injury to the jugular vein carotid artery or the tumor, in the event that it is very vascular

The ideal treatment would be to excise surgically carotid body tumors while they are still small and before they have grown sufficiently to involve the carotid vessels, which may require ligation either of the common carotid artery or it and one or both of its branches.

When the diagnosis of a carotid body tumor is reasonably certain or strongly suggested the patient should be prepared preoperatively for the possible or probable ligation of the common carotid or the internal carotid artery This preparation consists of the periodic compression of the carotid artery to improve collateral circulation of the brain The compression is developed gradually and continued for four or five weeks until the common carotid can be compressed for ten minutes four five, or six times daily without fainting dizziness, or muscular weakness, or sensory disturbances on one side of the body The compression is best done either by digitally pressing the carotid artery against the transverse process of the sixth cervical vertebra (Matas) or Richard's light pressure apparatus Complete compression of the vessel results in the absence of the temporal pulse, and the thrill and bruit if previously felt and heard over the tumor will disappear

Even compression for a period of ten minutes three four or five times a day for a period of several weeks, does not insure the patient against developing a vascular accident as hemiplegia, following ligation of the common carotid artery This was shown in the series reported by Lahey and Warren Two of their patients who withstood preoperative compression of the carotid artery without any symptoms developed hemiplegia and expired following the ligation of the carotid artery during the excision of a tumor In another one of their cases hemiplegia developed, even though the tumor was dissected free from the carotid vessels A sclerotic plaque was displaced from the intima during the manipulation of the tumor and produced complete fatal carotid thrombosis

With these thoughts in mind what should be the logical therapy suggested to the patient with a probable carotid body tumor? The patient and his family should be warned of the dangers of the operation and permission obtained to do what is necessary, within reason. The tumor is exposed and if found to envelop the common carotid, internal and external carotid arteries completely a biopsy should be taken for frozen section. The neck should be carefully examined for local extension to the contiguous structures. If the biopsy is positive for malignancy, the common carotid below, the external and internal carotid arteries above, and the internal jugular vein above and below, should be ligated and severed, the tumor completely excised together with a radical excision of the lymph node-bearing fascia, which would include the sternomastoid muscle and contiguous structures. Every effort should be made to remove a carotid body tumor but if it is inoperable the wound may be closed and the tumor palliated with irradiation.

If the tumor is small and examination reveals that it can be dissected free from the carotid vessels a rubber-shod bulldog clamp placed on the carotid artery proximal to the tumor frequently will assist in the surgical dissection of the tumor by preventing troublesome oozing from the very vascular growth The bulldog clamp may be left on the vessel for fifteen or twenty minutes without danger if the patient has been properly prepared by digital compression of the carotid artery

The reports of the response to irradiation therapy vary Bevan and McCarthy recorded a good response to irradiation of a carotid body

tumor which was explored but not removed. The authors have had one such good palliative result Phelps, Case and Snyder reported seven proved cases of carotid body tumor treated with irradiation (x ray and radium) without any appreciable benefit In their series of eighteen patients Lahey and Swinton report three treated with irradiation therapy with only slight reduction in the size of the tumor

CYSTIC HYGROMA COLLI

Cystic hygroma is a definite disease entity It is a benign multilocular cystic tumor of



Fig. 513 Cystic hygroma present since birth Both submaxillary areas involved, forming horse-collar type deformity Structures of floor of mouth are pushed upward by the enlarging tumor Surgical excision with no recurrence

lymphatic origin and lined with endothelium It may occur in the neck (93 per cent of the cases) axilla retroperitoneal and popliteal areas Twenty cases occurring in the neck were operated at the Johns Hopkins Hospital from 1930 to 1946 seventy nine per cent occurred before ten years of age and half of them immediately after birth The left side of the neck is more frequently involved than the right

The etiology of cystic hygroma has been intensively studied by McClure and Sylvester Sabin *et al* and Emil Goetsch whose work added much to the understanding of this abnormality During the early development of the embryo a capillary plexus is formed from the jugular vein on each side. Frequently in certain areas, capillary plexuses are cut off from the parent vein and form the anlage of the lymphatic system. The capillary plexuses are lined with endothelium and later coalesce and dilate forming the jugular sacs, one on each side of the neck The jugular sac on the left side connects with the thoracic duct and both join the internal jugular vein. Similar development takes place on the right

Areas of sequestrated embryonic lymphatic tissue are present along the jugular sacs and retain their power of growth as evidenced by developing fibrillas and membranous sprouts from the lining of the walls of the cystic spaces. The fibrillas and sprouts penetrate the surrounding tissues and may secrete droplets of fluid and form small cysts. Such tiny cysts cause pressure necrosis of the tissues they infiltrate and as growth continues, large multilocular cysts result

As the cysts enlarge they may extend along fascial planes or penetrate muscles, nerves or surround the larger blood vessels. If located beneath the deep fascia they may extend into the mediastinum or if superficially located extend from the neck across the clavicle onto the chest wall or into the axilla. Cystic hygromas that involve the submaxillary area may produce pressure on the floor of the mouth pharynx, or larynx (Fig 513) The tumor may extend from the mastoid process to the clavicle (Fig 514 A and B) or be limited to a small area in the posterior triangle of the neck or supraclavicular area and produce few if any symptoms (Fig 515)

Cystic hygroma, as a rule, develops rather slowly permitting the surrounding structures to accommodate themselves to the enlarging cystic mass On the other hand rapid growth may ensue and reach immense size within a period of days or weeks obliterating the surface markings of the neck and producing embarrassment to respiration and deglutition The cysts that extend from the neck to the mediastinum eventually cause pressure on the trachea and esophagus When limited to the neck (Fig 516) the tumor may surround the brachial



Fig 514. A. Cystic hygroma, female patient three years of age. The tumor was 1–2 cm in size when first observed shortly after birth. History of gradual increase in size to that of a large walnut. Four days before admission to the hospital, patient fell from high chair and struck her neck over the tumor with rapid increase in size of the tumor to that of a grapefruit. Skin over tumor was reddish-brown in color the patient complained of pain in right side of neck. Surgical excision the tumor measured 7 x 15 cm. The contained fluid was reddish in color with many red blood cells and leukocytes. B Wound ten days postoperative no recurrence of tumor



Fig. 515 Cystic hygroma, supraclavicular fossa, 9 months duration. White female patient, 6 years of age tumor first observed in the right supraclavicular fossa following a struggle with another child. Painless, diffuse swelling measuring 5 x 6 cm. soft in consistency and fluctuant. Tumor surgically excised contained reddish brown fluid no recurrence.



Fig. 516. Cystic hygroma. Male patient, 11 years of age. Five years ago, a tumor was observed in the left side of the neck which gradually increased in size and now extends over the clavicle onto the anterior chest wall. The cystic hygroma had been aspirated elsewhere at weekly intervals for the past year The tumor was excised from the left side of the neck, left anterior chest wall and found to extend beneath the sternomastoid pectoralis major and minor muscles also into the axilla to the border of the latissimus dorsi muscle. There was no recurrence. (Figs. 515 and 516 through the courtesy of West. Journ. Surg., Gyn. & Obs., Vol. 58, No. 2 Feb 1950)

plexus causing pain and hyperesthesia in the arm and hand on the same side

An upper respiratory infection may be followed by secondary infection in the hygromatous mass and due to the increased vascularity of the hygroma acute toxemia and/or septicemia may result

Hygromas often are multilocular, the cysts varying in size from a few millimeters to that

of a lemon The walls of the cyst first are thin fragile and transparent After a period of time fibrosis ensues the walls become thick and may contain muscle nerve or other tissues which the cysts have permeated The cysts are soft fluctuant and not tense the contents are serous, watery and straw-colored. Following trauma the contents may be bloody Lymph tissue or nodes may be adherent to the cystic mass or incorporated in the walls of the various compartments The lining of the cystic cavities



Fig. 517 Lipoma right side of neck simulating cystic hygroma Male patient 8 months of age. At 6 weeks of age a cystic mass developed below the right mandible which has gradually grown in size until it extends to the clavicle Cyst is smooth round soft in consistency not fluctuant adherent to deep structures and seems multiloculated. Surgical excision for cystic hygroma It was found to be a lipoma

is pearly white, simulating in this respect the pleura of peritoneum

It may be necessary to differentiate cystic hygroma from thyroglossal and branchiogenic cysts. Thyroglossal cysts occur in or near the midline of the neck above or below the hyoid bone if below a cord of tissue may extend from the cyst to the hyoid bone Branchiogenic cysts occur more frequently at or below the angle of the jaw are deeply located tense localized and seldom are very large The contents of a branchiogenic cyst is thick heavy grumous material The cyst is lined with squamous cell epithelium. Lymphoid tissue is contained in the cyst wall. Lipomas may also simulate cystic hygromas (Fig 517) Lipomas may be deeply situated the edges are not well defined they are not fluctuant A discrete tuberculous lymph node or solitary malignant lymphoma may simulate a small cystic hygroma. A dermoid cyst in the neck may be differentiated by its doughy consistency

TREATMENT

The treatment of cystic hygroma of the neck remains a problem Fifty per cent occur in very young children Frequently there is rapid growth with pressure symptoms, making their removal mandatory often requiring extensive dissection. X ray and radium therapy were used in the past Figi reported a group of cases treated at the Mayo Clinic with irradiation with a mortality of 54 per cent Incision and drainage of the cyst is mentioned only to be condemned—it is not a curative procedure and invites infection

The most rational therapy is surgical excision of all endothelial tumor tissue Sclerosing solutions have proved a valuable adjunct to surgical excision in the larger growths of short duration If judiciously used sclerosing solutions will temporarily shrink the cyst making its removal easier and safer These cysts are multilocular it is imperative that each daughter cyst be punctured, aspirated and injected if the sclerosing solution is to be effective in destroying (at least in part) the endothelial lining Strict asepsis must be observed to prevent infection from developing and causing the death of the patient

C R Edwards was one of the first to use this method of controlling large cystic hygromas and has contributed much to the variable factors associated with the use of sclerosing solutions. Early he found that 25 per cent glucose solution is better tolerated in small infants with large cysts than other types of sclerosing solutions In older children and in adults sodium morrhuate is used the amount depends on the size of the cyst seldom more than 10 cc is injected

A pressure dressing is placed over the cyst after injection to prevent it from immediately refilling

Intratracheal anesthesia is the anesthetic of choice The cyst is surgically excised three to six weeks after injection. An incision is made over the cyst in the lines of the neck, removing a generous amount of atrophic skin, which assures rapid healing of the wound The tumor and all of its ramifications must be dissected out older cysts are adhered to vital structures, i.e., carotid artery, vagus nerve brachial plexus trachea, esophagus, or may extend into the mediastinum. The thoracic duct on the left side of the neck is particularly liable to injury if care is not exercised in the dissection in that area A small rubber tissue drain is left in the wound two to three days Satisfactory healing is assured if all involved endothelial tissue is removed Multiple stage operative procedures were formerly necessary for the safe and complete removal of the cyst. With the development of aspiration and injection of sclerosing solutions multiple operative procedures are less frequently necessary

From 1926 through 1946 twenty patients were operated upon for cystic hygroma of the neck in the Johns Hopkins Hospital Ward Hendrick and Chambers (1950) reported the results of surgical excision, the treatment followed in each case. Some cysts were aspirated for diagnosis It was difficult to follow all the patients, as many were operated upon over twenty years ago in their infancy or early childhood All patients were examined one to four years after operation From the literature the impression is obtained that if recurrence develops it will appear within the first post operative year In the twenty cases reviewed, there were no operative fatalities and no known recurrences.

CARCINOMA OF THE THYROID GLAND

The thyroid gland is frequently the seat of functional disturbances associated with benign hypertrophies and hyperplasias, with or without hyperthyroidism. Benign encapsulated adenomas are frequently encountered Malignant tumors of the thyroid comprise about one per cent of all human cancer even though they are not as common as some forms of malignancy, but because of their great variability unlimited predictability, and clinical behavior they as a group, are one of the most interesting types of cancer in the entire field of oncology Some forms of thyroid malignancy may simulate clinically the frequently encountered benign adenoma, but during their apparent benign period local and distant metastases may develop via blood stream and lymphatics.

In a series of 112 carcinomas of the thyroid gland studied at the Johns Hopkins Hospital there were seventy four females and thirty eight males This ratio is in contradistinction

TABLE 39

AGES OF 112 CARCINOMAS OF THE THYROID GLAND

1–10 years of age	3 (youngest 4 years of age)
11–20 years of age	2
21–30 years of age	17
31–40 years of age	20
41–50 years of age	22
51–60 years of age	26
61–70 years of age	20
71–80 years of age	2 (oldest 80 years of age)

to that usually encountered in patients with goiter in the latter, the ratio of females to males is about six to one Both the white and colored races are involved There were eighty two white and thirty negro patients

Cancer of the thyroid gland may occur at any age (Table 39) It is more frequently encountered in the age group of forty to sixty years. There were three cases under ten years of age and twenty two under thirty In children it is the most frequent cancer of the head and neck.

ANATOMY

The thyroid gland is a bilaterally symmetrical organ formed of two lobes one lying on each side of the trachea and united by a thin layer of tissue the isthmus Frequently a third lobe (pyramidal lobe) is present, which

arises from the upper border of the isthmus and may extend to the height of the hyoid bone The two lateral lobes extend from the thyroid cartilage to the sixth tracheal ring The isthmus connecting the lateral lobes usually covers the anterior surface of the second third and fourth tracheal rings. The lateral lobes are related posterolaterally to the carotid sheath and its contents medially to the esophagus trachea and recurrent laryngeal nerves (Fig 518) The average weight of the thyroid gland is between 20 and 30 grams The right lobe is commonly a little larger and extends a little higher in the neck than the left The pyramidal lobe may be represented only by a fibrous cord at other times it may be large and contain 3 to 5 grams of tissue It as well as the rest of the thyroid may be the seat of malignancy benign adenomas, or functional hyperplasias and hypertrophies. The surface of the lobes is made up of low lobulations and is never smooth like the spleen or liver The gland is enveloped by a thin connective tissue capsule which continues into the gland as septa The pretracheal fascia firmly fixes the gland to the cricoid and thyroid cartilages it therefore moves up and downward with deglutition. As the age of the individual increases, the gland becomes firmer due to progressive fibrosis

The thyroid gland has a rich arterial blood supply The superior thyroid arteries arise from the external carotids the inferior thyroid arteries from the thyro-cervical trunks and a branch frequently present the thyroidea ima from the innominate artery (Fig 519) There are four sets of venous channels the superior middle and lateral and medial inferior thyroid veins the latter drain into the innominate vein

The Lymphatic System of the Thyroid Gland

The lymphatic system of the thyroid gland was carefully worked out by Rouviere and Most and is important in considering the problem of malignancy The lymphatic channels begin as a rich delicate network around the thyroid follicles and extend peripherally through the gland into collecting trunks which drain into six groups of lymph nodes. The multiplicity of directions of lymphatic flow from the various parts of the thyroid gland account for the extensiveness of node metastases that may occur It is important if possible to determine the part of the gland that is primarily involved in order to evaluate the probable extension of metastases into the surrounding nodes The collective trunks and nodes draining the thyroid gland are as follows (Rouvière and Most) The superior median trunks arise in the upper medial part of the lateral lobes and isthmus and travel upwards in front of the larynx to end in the sub-digastric group of nodes some of the trunks may empty into one or two nodes in the inter cricothyroid area The inferior median trunks of the lower part of the isthmus and lower medial part of the lateral lobes drain into the inferior jugular chain of nodes (Fig 520) in the lower pretracheal nodes and some extend into the brachiocephalic nodes and the nodes in the thymic gland The trunks from the posterior surface of the lower poles of the lateral lobes drain into nodes in the sulcus, posterior to the gland along the recurrent laryngeal nerves. The trunks that arise from the upper lateral part of the lobes extend in an upward direction and drain into the superior nodes of the internal jugular chain. The ones from the middle third of the lateral lobe extend in a lateral direction and enter the jugular chain It will be noted from Figure 520 that lesions developing in the isthmus or the medial part of the lateral lobes may develop a bilateral metastasis.

Incidence and Etiological Factors

During the past twenty five years substantial progress has been made in the diagnosis and treatment of thyroid malignancy In 1924 Allen Graham clearly demonstrated the significance of blood vessel invasion as a criterion for diagnosis of thyroid malignancy Graham's work also brought out the relationship of discrete adenomas to thyroid malignancy and showed that distant metastases

Com carotid a
Sup. thyroid a
Int jugular v
Sup thyroid v
Cricothyroid m
Com carotid a
Thyroid ima a
Int br
Ext br
Sup laryngeal n
Thyrohyoid membrane
Thyrohyoid m
Pyramidal lobe
Sternothyroid m (cut)
Vagus n
Mid thyroid v
Inf thyroid a
Subclavian a
Innominate v
Inf thyroid vv

Fig. 518. Anatomy of the thyroid gland, anterior view Note the pyramidal lobe extending to the superior border of the thyroid cartilage the lateral thyroid veins emptying directly into the jugular vein. These veins are short, their walls are thin and in large adenomas, they may be of large size. If not properly ligated during operative procedures on the thyroid, they can be a source of troublesome hemorrhage, and by grasping with a hemostat the recurrent nerve may be injured.

Sup. laryngeal n
Int jugular v
Sup thyroid a
Vagus n
Inf thyroid a
Oesophagus
Trachea
Recurrent laryngeal n.
PHARYNX
Epiglottis
Com carotid a
Sup parathyroid
Inf parathyroid
Recurrent laryngeal n.
Subclavian a

Fig. 519 Anatomy of the thyroid gland, posterior view Note that the inferior thyroid arteries have their origin from thyroid axis and pass immediately behind the carotid artery and jugular vein to enter the thyroid gland at the posterior lateral surface dividing into several branches as the vessel ascends toward the superior part of the gland the parathyroid glands relationship to branches of the inferior thyroid artery (Drawn from cadaver dissection.)

may develop by blood stream invasion from a clinically benign adenoma. Previous to 1924 pathologists had difficulty in making a correct early diagnosis in a substantial percentage of malignancies of the thyroid gland Frequently only late cases were diagnosed that had large fixed glands which had infiltrated the surrounding structures associated with hoarseness pain obstructive symptoms of the trachea, and at times, the esophagus.

Now the relationship of discrete adenomata to thyroid malignancy is appreciated by students of thyroid disease but there are still

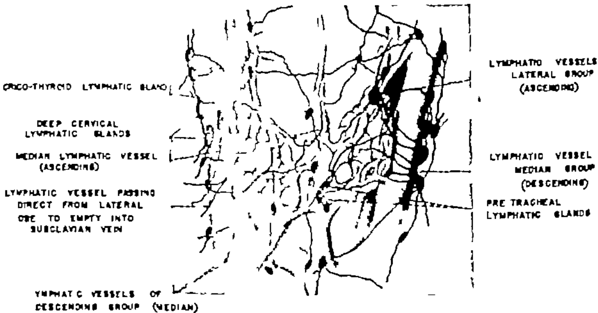


Fig 520. The lymphatic drainage of the thyroid gland. Note that tumors arising from the isthmus or me half of the lateral lobe have a bilateral anastomosis of the lymphatic channels. Tumors arising from the me areas of the lateral lobes and isthmus may metastasize to the lymph nodes over the thyroid cartilage and to mediastinal nodes (A composite drawing based on the work of Rouviere, Most, Major and Mahorner et al.)

many physicians who do not realize its importance There is more than a casual relationship between discrete adenomas and thyroid malignancy (Fig 521 A and B) It is definitely established that pre-existing benign adenomas is the most important known etiological factor in the development of thyroid malignancy It is not uncommon to see an encapsulated degenerating adenoma of the embryonic or fetal type harbor an early malignancy that has and is, producing regional and distant metastases yet appears clinically benign

It is assessed that 80 per cent of thyroid malignancies arise in fetal adenomas. T development of malignancy in discrete ader mas of the thyroid and adenomatous goi has been discussed at length by numerous vestigators (Fig 522 A B & C) It is es mated that from four to 20 per cent of t discrete adenomas developed into malignan irrespective of the age. It is mandatory the fore that all discrete adenomatas be remov before silent or frank malignancies devel Over 60 per cent of thyroid malignancies of low grades histologically which frequen permits them to be present for months, even years before they produce clinical dence of their presence. Such cases invaria are associated with a discrete adenoma adenomatous goiter

The relationship of carcinoma of the thy to hyperthyroidism (hyperfunctioning aden atous and exopthalmic goiter) has b stressed during the past few years by vari investigators Rienhoff and Lewis dem strated that 8 per cent of the hyperpla glands they studied contained fetal adenom Black reporting from the Mayo Clinic st that 16 per cent of their cases of thyroid ma

nancy were associated with exopthalmic goiter, and 18 per cent were associated with adenomatous goiter with hyperthyroidism. Pemberton reporting from the same Clinic, using the basal metabolic rate as a criterion of hyperthyroidism, found 33.5 per cent of a group of thyroid malignancies had a basal metabolic rate above normal. In the group of cases being reported from the Johns Hopkins Hospital there were symptoms of hyperthyroidism in thirty or 26 7 per cent (Fig 523 A, B C) Our criteria ism and the malignant lesion is not clear Frequently the carcinoma was found to involve only part of one lobe, which should not be a contributory factor in producing an elevation of the basal metabolic rate (Fig 524 A–D)

In this group of patients, eighty-seven (77 per cent) gave a history of thyroid abnormality existing previous to the symptoms of carcinoma it is of interest that twenty patients had an aberrant position of the initial tumor



Fig 521 Benign adenoma

A. White male fifteen years of age adenoma 2 cm in diameter present two years.
B Encapsulated fetal adenoma showing follicles of varying size lined with low cuboidal epithelium containing a watery type of colloid Nests of epithelial cells, not forming acini present. Adenoma well encapsulated and benign.

of symptoms of hyperthyroidism are tachycardia sensitivity to heat weight loss, excessive appetite and nervousness. Twenty-four or 21 per cent of the patients with symptoms of hyperthyroidism had an elevated basal metabolic rate (i e above plus 15) The highest metabolic rate reading was 109 per cent It was further noted that cases with moderate or high histological grades of malignancy had more evidence of hyperthyroidism than those with a histological grade I or II malignancy The association of hyperthyroid (Table 40) It may be interpreted from this that the patient had an involvement of the thyroid some period of time before the nodes in the cervical area were observed Aberrant papillary malignant tissue in reality represented *metastases from the lobe of the involved side*

Classification of Malignant Tumors of the Thyroid Gland

There is perhaps a wider variation in the histopathology of benign and malignant tumors

of the thyroid than found elsewhere except in the osseous system. Not always is there a definite relationship between the clinical course of the tumor and the pathological findings. However many attempts have been made to formulate a satisfactory clinical and pathological classification of malignancies of the thyroid. Most experienced pathologists and surgeons have found that the clinical symptoms and pathological pictures are distinctive and constant enough to lend themselves, to a degree at least, to clinical pathological grouping. The essential features are rather constant in all groupings. The following classification as suggested by Shields Warren, adopted from Allen Graham and used by the



Fig. 522. Papillary carcinoma, thyroid gland.

A. White male child, four years of age. History of adenoma in thyroid since six months of age. Two years ago began to enlarge; deviation of trachea; pressure symptoms.

B. Cross section of tumor; cystic areas present. Papillary projections in some of cystic areas.

C. Photomicrograph reveals papillary growth of epithelium. Papillations are covered with columnar cells, varying in size with basal placed nuclei that are hyperchromatic. Capsule of adenoma present in one area but shows invasion by tumor.



Fig 523 Giant cell carcinoma in diffuse toxic goiter

A White female 42 years of age. Nodular enlargement of thyroid two years duration. Symptoms weight loss, nervousness, very sensitive to heat, tachycardia basal metabolic rate, 38. Diagnosis Diffuse toxic goiter
B Photomicrograph Acini shows papillations and spur formations increased vascularity areas of lymphoid infiltration watery type of colloid
C Photomicrograph of one firm area in specimen shows infiltration with large giant cells with dark-staining nuclei. Diagnosis Giant cell carcinoma in hyperplastic or diffuse toxic goiter

American Goiter Association seems to be practical both clinically and histologically and is widely accepted We give the number of our cases falling into each group (Histological studies by Dr Morgan Berthrong of the Department of Pathology Johns Hopkins Hospital and Dr Robert G Chambers)

Group I Low Grade Malignancy

Malignant Adenoma (with blood vessel invasion) and Papillary Cystadenoma

This group as the name suggests, has its etiology, in most instances, in benign embryonal or fetal adenomas that occur as discrete or less commonly multiple adenomas

The structure of this tumor varies within wide limits in some the normal architecture is preserved and in others the adenoma is completely replaced by branching columns of undifferentiated cells Most of these tumors are of low histological grade of malignancy either I or II but occasionally may be grade III and IV This type of tumor does not metastasize

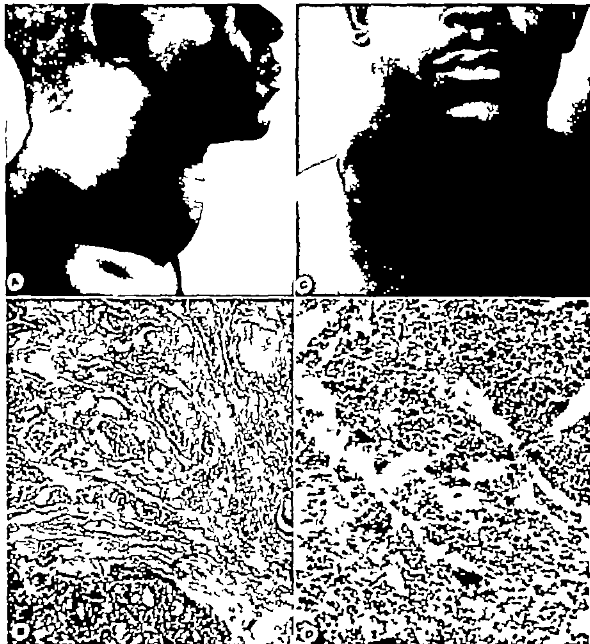


Fig. 524 Carcinoma in diffuse toxic goiter

A. Patient colored male with history of diffuse enlarged thyroid, with mild evidence of hyperthyroidism of two years duration No clinical evidence of malignancy present

B Photomicrograph showing poorly formed acini with watery type of colloid acini lined with low cuboidal epithelium infiltration with strands of epithelial cells with dark-staining nuclei invasion of blood vessels

C Recurrence right lobe Tumor hard nodular producing tracheal deviation no evidence of involvement of right recurrent laryngeal nerve

D Photomicrograph undifferentiated carcinoma of thyroid infiltration with strands and nests of epithelial cell some attempting to form acini Cells have hyperchromatic nuclei small amount of poorly-staining connective tissue

via lymphatic vessels until it has grown sufficiently to invade and disrupt its capsule It was in this group that Graham noted the frequency of blood vessel invasion and considered this phenomenon as the criterion of malignancy It is not unusual for these tumors to develop distant metastases, either to the lungs or osseous system through the blood stream, with little change in the size and clinical picture

TABLE 40

THYROID ABNORMALITIES EXISTING PREVIOUS TO CANCER

1 Discrete Adenomata in a normal position	23
2. Aberrant position	20
3 Multiple adenomata	16
4 Bilateral adenomata	5
5 Diffuse involvement of the entire thyroid	23
6. One lobe diffusely involved	10

TABLE 41

CLASSIFICATION OF THYROID CANCER

1 Low grade malignancy	
a. Adenoma with blood vessel invasion	36
b. Papillary cystadenoma (a and b are frequently grouped together)	25
	—
	61
2. Moderate grade of malignancy	
a. Papillary adenocarcinoma	20
b. Alveolar adenocarcinoma	11
c. Hürthle cell carcinoma	6
3 High grade malignancy	
a. Small cell or carcinoma simplex (compact and diffuse type)	5
b Giant cell carcinoma	1
c. Epidermoid carcinoma	3
d. Fibrosarcoma	4
e Angiosarcoma	1

of the parent tumor This was noted in a white female aged 32 with a pathological fracture of the left humerus. Aspiration biopsy revealed tissue resembling thyroid. Investigation of the thyroid showed a small discrete adenoma, 2 cm. in diameter movable and firm, but not hard Enucleation revealed carcinoma with blood vessel invasion. The capsule was intact No lymph node metastasis was discernible The pathological fracture responded moderately to irradiation, but the patient developed extensive metastases within a few months to the lungs and other areas of the osseous system.

Another female patient aged 46 gave a history of an adenoma of the left lobe of the thyroid during pregnancy when she was thirty eight years of age. It disappeared after delivery and re-appeared eight years later with rapid growth and at operation, a malignant adenoma was found. The veins of the capsule were grossly invaded with cancer

A third patient, a male thirty-seven years of age gave a history of a discrete adenoma in the left lobe of his thyroid gland since he was seventeen years of age It had been removed three times previous to admission (each excision had been done in a minor operating room under local anesthesia) On examination a diffuse involvement of the entire left lobe of the thyroid was present and a nodule in the left supraclavicular area. A hemithyroidectomy with a radical neck dissection was done a papillary carcinoma was found with involvement of the lower jugular chain of nodes.

Twenty patient had undergone previous thyroid operations. Several came to our clinic because of a local recurrence or had been advised that they had a malignancy and further surgical therapy or irradiation was necessary It was not always possible to determine whether the previous operation was done for a benign or malignant condition however all patients who were re-operated were found to have malignancy

So-called lateral aberrant thyroid tumors have been the subject of controversy for many years It is established that the true origin of the thyroid is from the central anlage but it has been contended by many in the past that there occasionally develops laterally from one or both sides of the neck papilliferous glandular structures from the ultimobranchial body which have been designated as lateral aberrant thyroid tissue (Chapt. II Embryology) When present they are discrete gland like masses that vary in size and consistency in the lateral surface of the neck and usually

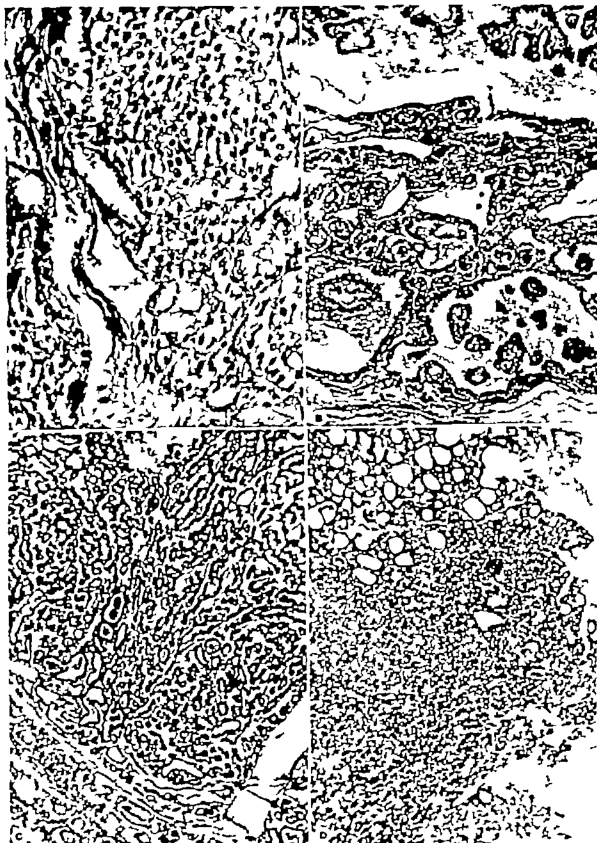


Fig 525 Illustrating some of the various histological types of thyroid gland carcinoma

A. Adenoma with blood vessel invasion White female aged 13 years. Poorly formed acini with low cuboidal epithelium Watery type of colloid Blood vessel invasion

B Papillary cystadenoma White male 6 years of age Papillary cystadenoma Small cyst lined with papillary epithelium some forming small acini Capsule of adenoma not invaded

C Papillary adenocarcinoma developing in an adenoma Epithelium forming papillations In some areas several layers in thickness. Cells contain dark staining nuclei Some attempting acini formation

D Photomicrograph of alveolar adenocarcinoma showing infiltration with epithelial cell Some attempting acini formation Epithelial cells vary in size shape and chromaticity In one section normal appearing thyroid tissue



Fig. 525 (E-H)

E Photomicrograph anaplastic Hürthle cell carcinoma. Invasion with large epithelial cells with clear cytoplasm with moderate sized nuclei and deeply-staining nucleoli. Cells resemble liver cells.

F Carcinoma simplex. Photomicrograph shows invasion with strands, sheets, and nests of epithelial cells in compact and diffuse formations. Cells vary in size, shape, and chromaticity

G Giant cell carcinoma. Photomicrograph showing infiltration with large epithelial cells containing lar hyperchromatic nuclei. Scant amount of edematous connective tissue.

H Fibrosarcoma. Thirteen year-old white female. Infiltration with clumped oblong cells, with light-st nuclei. Little connective tissue remaining.

along the anterior border of the sternomastoid muscle or just under it along the course of the internal jugular vein Such tumors have been called lateral aberrant thyroid tumors. It was shown by Lowe in 1903 that the thyroid tissue found in the lateral surface of the neck was similar histologically to tumors present in the thyroid gland It was thought for a period (Fig 526) of years that the associated papillif erous change of a malignant nature found in the corresponding lobe of the thyroid was an extension to the thyroid from the malig nancy in the lateral cervical aberrant tissue Pemberton contends that lymph flow is centrif ugal and few if any tumors metastasize into the thyroid gland If a tumor does metastasize into the thyroid it travels by blood vessel invasion and not through the lymphatic channels However Wohl in 1917, considered them to be metastatic lesions from the papillary adenocarcinoma of the thyroid When such nodules first appear they are of slow growth and are often construed as inflammed cervical lymph nodes Their association with a similar co-existing papilliferous nodule in the thyroid has been the cause of the controversy but in late years most authorities consider the laterally occurring thyroid nodules as metastases in lymph nodes from a primary malig nant adenoma in the thyroid

Fig. 526 (A)

Fig 526. Carcinoma thyroid gland metastases to regional lymph nodes

A Artist s conception of illustrating metastatic involvement of jugular chain of nodes from small tumor in the right lobe of thyroid. (1) Illustrates position of enlarged node removed in 1936 with a diagnosis of carcinoma of thyroid tissue (2) Illustrates position of enlarged nodes removed in 1942 with a diagnosis of carcinoma of thyroid tissue (3) Illustrates position of enlarged nodes when patient returned in 1947 also location of tumor found at operation.

This type of thyroid malignancy frequently develops insidiously and slowly. It is not unusual to find small nodular masses in the lateral cervical area, either single or multiple with operation both lobes of the thyroid appeared to be normal but on further examination a small nodule was found in the posterior medial area of the left lobe and when removed with the lobe, measured 7 mm in diameter and contained papillary carcinoma. Nodes

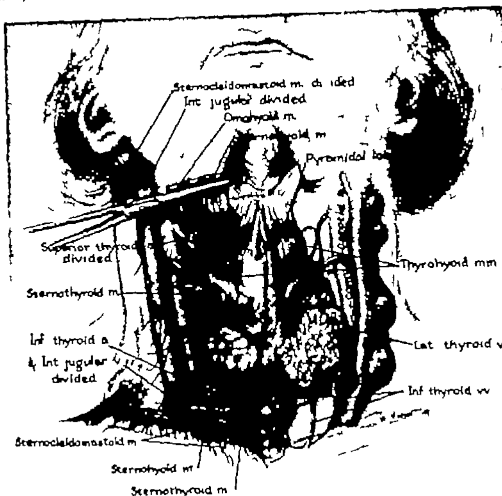


Fig. 526 (B)

Fig. 526B Artist's conception of metastases to jugular chain of nodes from tumor left lobe of thyroid. Patient white female, had tumors removed from left side of neck, as indicated in 3 and 4 on two occasions previous to admission to the Johns Hopkins Hospital diagnosis, papillary carcinoma. No tumor observed in the left lobe of the thyroid gland at that time. Recurrence of the nodes in the lower area of the neck indicated by Figs. 1 2 5 at operation papillary carcinoma left lobe of thyroid, with metastases to the cervical lymph nodes. Operation radical neck dissection, hemithyroidectomy. No recurrence. (Courtesy Ward Hendrick, Chambers, Annals of Surgery Vol. 131 April 1950)

little evidence of involvement of the corresponding lobe of the thyroid. This is shown by the following case report

A female patient aged twenty-one years, was referred because two months previously she had three nodes removed from the left lateral cervical area, which were diagnosed as papillary carcinoma grade 1 of lateral aberrant thyroid tissue. When examined there was little evidence of involvement of the left lobe of the thyroid gland. It was suggested, however that hemithyroidectomy and a left neck dissection be done. This was promptly refused by the patient and her physician. When seen again four years later she had four other palpable nodules in the same lateral cervical area. At resected in the lateral cervical area contained the same type of tissue. The right lobe was normal.

The second case history further illustrates the same point. A forty-eight year-old white female had had nodules removed from the right lateral cervical area on two occasions over a period of ten years. Pathological diagnosis was carcinoma of thyroid tissue. The patient returned with other nodules in the lower right cervical area each measuring about 1.5 or 2 cm in diameter. The thyroid was apparently normal on examination. At operation the thyroid was normal in appearance but when the lateral thyroid vein was ligated and severed and the right lobe rotated medially a small tumor about 1 cm. in diameter was found with evident degeneration calcification and a papillary carcinoma

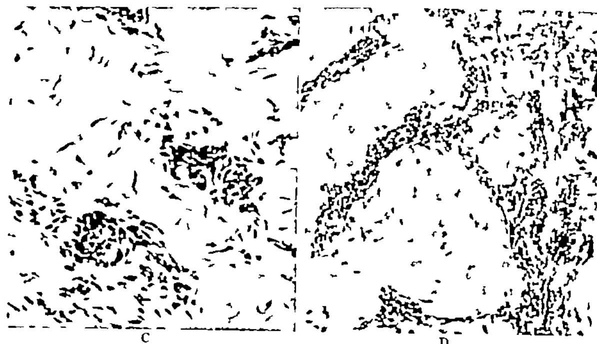


Fig. 526 (C–D)

C. Photomicrograph showing dense fibrous connective tissue containing strands and isolated epithelial cells varying in size, shape and chromaticity from right lobe of thyroid.

D. Photomicrograph of lymph nodes showing infiltration with epithelial cells. Cells containing dark-staining nuclei. (Courtesy Annals of Surgery.)



Fig. 52 Papillary carcinoma, thyroid gland

A. Patient 64 year-old white male treated for basal cell carcinoma of the nose with good results, no recurrence. Gave history of having had an adenoma of left lobe of thyroid gland for several years. During the past year noticed a rather marked increase in size of adenoma. During the past four months, there was marked increase in size with shortness of breath, choking attacks. Examination: A rather firm tumor measuring 6 x 10 cm. occupied the left lobe of thyroid, producing tracheal deviation.

B. Photomicrograph. Infiltration of the growth with papillations covered with columnar epithelium and polyhedral type cells. Cells covering papillations in some areas are several layers thick; in other areas there is attempted acini formation with watery type of colloid. The capsule of the adenoma is intact; normal appearing acini outside of adenoma.

Grade I A hemithyroidectomy was done. The same type of tissue was found in the lateral cervical nodes when the radical neck dissection was completed. There has been no further recurrence (Fig 526, A B C and D)

Occasionally, the primary lesion may be very small and situated in the posterior medial position, consequently it is difficult to palpate before or even at operation. These tumors may

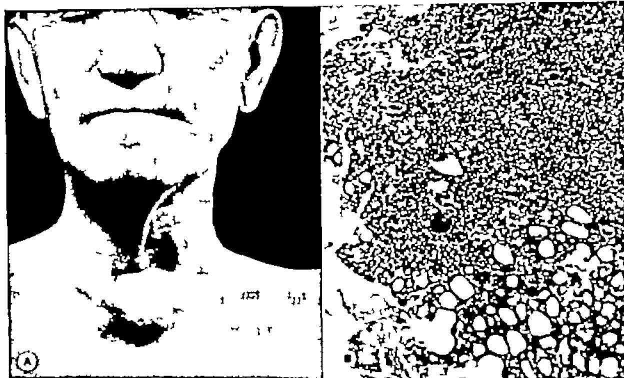


Fig. 528. Carcinoma thyroid gland

A. Patient white male 56 years of age, gave a history of having an adenoma of the left lobe of thyroid gland that gradually increased in size, was removed 8 years previously The pathological diagnosis was carcinoma of the thyroid gland. The patient returned following a follow up letter January 1949 stating that there was a recurrence of the tumor of left lobe of thyroid, beginning three years previously Examination Left lobe of thyroid measured 4 x 6 cm., was firm-to-hard in consistency The lower jugular chain of nodes, left side, were enlarged, palpable, and firm. One small firm node was found in the right lower jugular chain. At operation the left lobe and isthmus of thyroid contained a hard, firm tumor that extended into the anterior mediastinum. The lower jugular chain of nodes on the left side and a small node in the right lower jugular chain were involved.

B Photomicrograph of tumor shows infiltration with epithelial cells attempting acini formation Cells vary in size, shape, and chromaticity Some round cell infiltration. One area of normal-appearing thyroid tissue present.

be degenerated, fibrosed, and calcified. Such small lesions continually disseminate to the node-bearing area metastatic emboli until they are removed

Group II. Moderate Grade of Malignancy

Papillary Adenocarcinoma

Papillary adenocarcinoma may be readily distinguished histologically from other types of carcinoma of the thyroid gland by its papilliferous structure It commonly arises within an adenoma or occasionally from a portion of the gland that is free from adenoma. It differs from the malignant adenoma in that it is a less differentiated growth with a greater variability in the histological picture with moderate mitotic activity The papillary projections are covered with cuboidal or polyhedral cells, with or without well defined cell boundaries The cells may be several layers thick. There may be masses of cells without a lumen When a lumen is present it may contain a watery type of colloid.

The papillary adenocarcinoma may invade its capsule early and extend into the surrounding thyroid and adjacent tissue Frequently it has grown to such extent before operation that all evidence of its having developed in a pre existing adenoma is destroyed.

On the other hand the papillary adenocarcinoma may show little tendency to rapid growth even after it has invaded its capsule and metastasized to the cervical nodes. It is not infrequent for the parent tumor of the slowly developing type, as well as the cervical nodes, to remain in a more or less quiescent stage for a considerable period of time (Fig 527 A and B) It is with such a type that hemithyroidectomy with removal of the isthmus and a radical neck dissection will effect a non recurrence in a large percentage of the cases. At operation there may be wide involvement of the cervical nodes without involvement of the mediastinal or distant nodes, or metastases to the viscera or osseous system.

Pemberton has drawn an analogy between the biological characteristics of this type of carcinoma of the thyroid and papillary adenocarcinoma of the ovary

Alveolar and Hürthle Cell Adenocarcinoma

The former is composed of masses and strands of polyhedral and cuboidal epithelial cells which may form acini that contain poorly stained watery type of colloid The stroma is usually scant but in some cases may be abundant The epithelial cells never form papillary projections (Fig 528 A and B)

Hürthle cell adenocarcinoma is one of the rarer types of thyroid cancer and histologically simulates, to a degree the Hürthle cell adenoma (Fig 525 E) There are masses of small and large clear acidophilic cells which may or may not form acini and if present, seldom contain colloid Both the alveolar and Hurthle cell adenocarcinoma invade the surrounding thyroid tissue and other immediate structures early It has been suggested by some investigators that the Hürthle cell type of tumor is of parathyroid origin, but we feel that it is definitely a thyroid tumor

GROUP III HIGH DEGREE OF MALIGNANCY

There are numerous histological types represented in this heterogeneous group having their origin either within a pre-existing benign adenoma or arising from a non-goitrous gland. They present the wide variety of histological patterns and cellular changes observed in tumors of high histological grades encountered elsewhere in the body There were fifteen cases in this group

Small Cell or Carcinoma Simplex

In the compact form of the small cell carcinoma, the cells appear in solid masses, cords, and strands. In the diffuse form the cells may be disseminated among the scant or abundant connective tissue. Both types may have small polyhedral or cuboidal cells with deeply staining hyperchromatic nuclei and are well differentiated. In the diffuse type, they may resemble the picture of chronic thyroiditis, especially of Hashimoto's disease, or may resemble a lymphoma. Small psuedo acini may be present without any evidence of colloid (Fig 529 A B and C)

Giant Cell Carcinoma Epidermoid Carcinoma and Fibrosarcoma

The giant cell carcinoma epidermoid carcinoma, and fibrosarcoma represent a rapidly growing undifferentiated type of tumor that may have origin in a benign adenoma They present a bizarre type of histology with all extremes represented and may be so anaplastic that they are frequently thought of as sarcomas. The epidermoid carcinoma has two possible sources of origin thyroglossal duct remnants or metaplasia of the thyroid epithelium. All types of this highly malignant group rapidly invade the entire gland and surrounding structures

Angiosarcoma

One case of angiosarcoma occurred in this series, although we have failed to find any reference to this tumor in the literature

Lymphoma

Lymphomas of the thyroid are reported. None were encountered in this series. It is necessary to distinguish them from struma lymphomatosum of Hashimoto and carcinoma

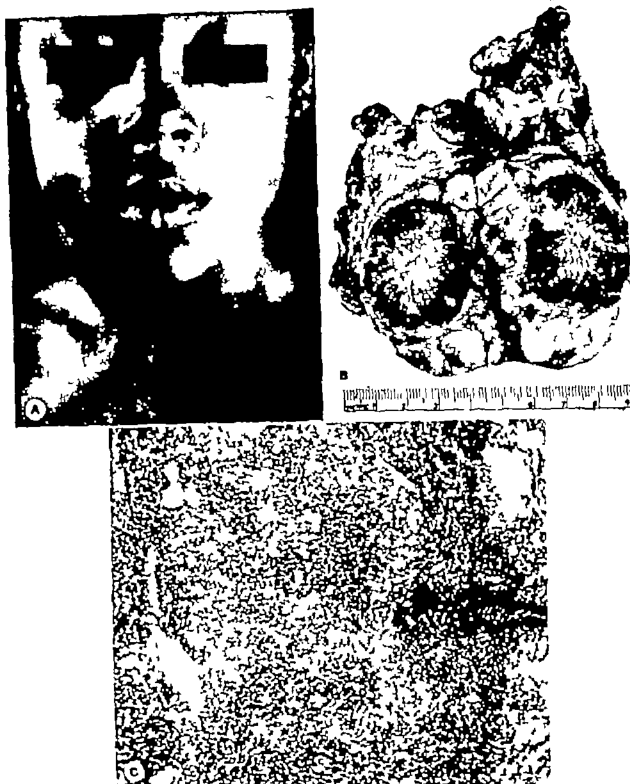


Fig. 529 Small cell carcinoma, thyroid gland

A. Patient 8-year-old colored male, with history of nodule, right lobe of thyroid, 4 years' duration. Began to grow rapidly during the past year Tumor is firm, practically immobile, producing tracheal deviation. Tumor measures 4 x 6 cm.

B Section of tumor shows lobulation one area where tumor has invaded the capsule also involvement of the lymph node that has been sectioned

C. Photomicrograph (high power) shows infiltration with small round cells varying in size and chromaticity A few are attempting acini formation.

simplex of the diffuse type. Occasionally the thyroid gland is involved secondary to lymphomas developing elsewhere

Criteria of Malignancy

Since discrete fetal or encapsulated adenomas have been incriminated so extensively as a causative factor of thyroid malignancy it is well to define and discuss them. Allen Graham and Shields Warren have treated this subject so thoroughly that we give a resumé of their findings as follows

Adenomas are completely encapsulated masses occurring discretely in a normal or hyperplastic gland with histological appearance varying from the remainder of the gland The usually complete encapsulation may be broken when malignancy has developed. There is a homogeneous texture grossly and microscopically throughout the adenoma with frequent areas of calcification fibrosis and degeneration There is evidence of compression of the surrounding normal thyroid tissue Several variations in the adenoma may be noted

1 The growth may be made up of closely packed cells, with or without much stroma and with little evidence of alveolar formation, and no colloid

2 The second type of adenoma is more differentiated and contains numerous fetal follicles, which may or may not contain varying amounts of a watery type of colloid. Cystic areas and areas of degeneration and hemorrhage may be encountered.

3 Another group is termed the simple adenoma with well-differentiated thyroid tissue having rather abundant stroma. It is definitely encapsulated and separated from the surrounding tissue and may have some functional activity

4 The last type of adenoma to be mentioned is also definitely encapsulated and shows normal looking follicles containing normal-appearing colloid in varying amounts. It may simulate the remainder of the thyroid tissue except that it is definitely encapsulated

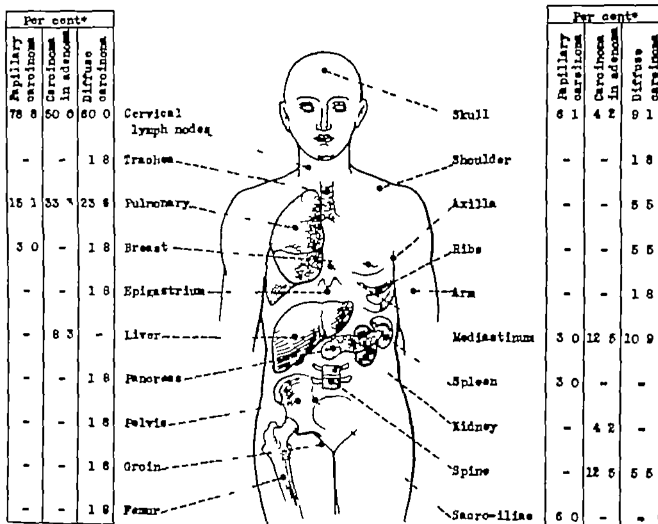
The most characteristic feature in determining malignancy in a substantial percentage of thyroid neoplasms is blood vessel invasion The common types of thyroid malignancy encountered are malignant adenoma and papillary carcinoma A large number of these lesions are of low histological grade I or II (Broder



Fig 530 Undifferentiated carcinoma, thyroid gland

A Patient, colored female 47 years of age history of adenoma left lobe of thyroid of 20 years duration. One year ago increased rapidly in size enucleation of adenoma metastases to the sternum and viscera, one year later
B Photomicrograph showing infiltration with epithelial cells in strands, nests. Cells varying in size with hyperchromatic nuclei Areas of degeneration present

Classification) which is in keeping with the clinical course of these tumors Other important factors are the extent of the vascular invasion, both microscopic and gross invasion of the veins of the capsule and the compactness of the growth within the adenoma determining to a degree the ease with which metastatic emboli may be broken off It is necessary to correlate the clinical findings with metastasizes either by the blood stream or by the lymphatic channels. It was mentioned previously that blood vessel invasion with metastases to the lungs and osseous system, or to other structures, may develop before there are clinical signs of malignancy in the primary thyroid adenoma On the other hand, it is only after this type of malignant adenoma has infiltrated through its capsule into the



Per cent* Papillary carcinoma	Carcinoma in adenoma	Diffuse carcinoma	Site
78 8	50 0	60 0	Cervical lymph nodes
-	-	1 8	Trachea
15 1	33 [illegible]	23 6	Pulmonary
3 0	-	1 8	Breast
-	-	1 8	Epigastrium
-	8 3	-	Liver
-	-	1 8	Pancreas
-	-	1 8	Pelvis
-	-	1 8	Groin
-	-	1 8	Femur

Site	Per cent* Papillary carcinoma	Carcinoma in adenoma	Diffuse carcinoma
Skull	6 1	4 2	9 1
Shoulder	-	-	1 8
Axilla	-	-	5 5
Ribs	-	-	5 5
Arm	-	-	1 8
Mediastinum	3 0	12 5	10 9
Spleen	3 0	-	-
Kidney	-	4 2	-
Spine	-	12 5	5 5
Sacro-iliac	6 0	-	-

Fig. 531 Percentage distribution of metastases of malignant tumors of the thyroid gland by site of metastases and type of tumor (Courtesy J D Pemberton and "Transactions American Goiter Assn " 1938.)

the pathological picture This is true of some of the higher grades of malignancy as represented by alveolar Hürthle cell and anaplastic types. The criteria used for diagnosis of malignancy elsewhere in the body that is cellular differentiation and anaplasia is of value in the more anaplastic types of growth

Metastasis from thyroid malignancy has been alluded to previously Malignant adenoma lymph spaces that metastases develop in the regional or distant lymph nodes These two features alone make it mandatory that all discrete adenomas be removed to prevent such catastrophes occurring without any warning to the patient

Papillary carcinoma arising in a previously benign adenoma metastasizes to the regional lymph nodes and not infrequently before many

clinical changes are noted in the adenoma It may be stressed again that this type commonly is of low histological grade, and the metastases may remain localized to the cervical nodes for long periods of time before they are disseminated to other lymphatic structures It is in this group that extensive surgical excision including hemithyroidectomy of the involved side with a radical neck dissection gives good results in a substantial percentage of the cases

Metastasis from the highly malignant group occurs through the lymphatic channels, the regional nodes being involved first, and later the metastases extending to other drainage areas. In this group it is also possible for metastases to spread by the blood stream as in other types of highly malignant carcinoma

The regional nodes were involved in seventeen cases, or 75 per cent of the twenty papillary adenocarcinomas. In the entire series of 112 cases, however the regional nodes, as well as distant nodes, were the seat of metastases in thirty nine cases (34.8%) In 6 cases there were metastases to the osseous system, and in eighteen to visceral structures the lung most frequently involved (Fig 530 A B) In three cases of the very anaplastic type of tumor (high grade malignancy) there were metastases to the regional and distant nodes, the osseous system and the lungs. Regional metastases from malignant adenoma and papillary adenocarcinoma are limited as a rule to one side of the neck Their growth is very slow and it is not unusual for these tumors to recur five to ten years or longer after they have been removed. Also since they grow slowly a patient may *live in relatively good health with* cervical or mediastinal metastatic nodes for a number of years. There may be a wide distribution of the metastases and the nodes along the larynx, trachea submaxillary and jugular chain may become involved. When the adenoma develops in the isthmus, there may be bilateral involvement from metastatic nodes. In the highly malignant group there may be bilateral metastases, especially if the isthmus is invaded as there is a cross anastomosis of the lymphatics.

The accompanying figure (Fig 531) from the Mayo Clinic shows the percentage of distribution of metastases of malignant tumors of the thyroid by types of tumor and to anatomical sites There were 112 cases with metastases in their group of 517 cases of carcinoma of the thyroid reported by Pemberton.

Clinical Behavior

There are no definite signs or symptoms of early cancer of the thyroid gland. A high percentage of thyroid malignancies are preceded by adenomas There are, however suggestive signs and findings which will lead the alert physician to a tentative diagnosis. Frequently the patient will notice a lump in the neck, either in the region of the thyroid gland or in the lateral cervical areas and will seek medical care after varying intervals of time. In this series, the average duration of symptoms before consulting the clinic was 3 8 years. The shortest time was two weeks, the longest was thirty eight years, a patient with adenoma that became malignant. The lump may represent a benign adenoma or an adenoma that has undergone malignant change or metastases in the lateral cervical area. The latter type of case comprises only a small group The history of recent increase in the size of a pre-existing adenoma or the recent development of a tumor with or without a sense of pressure in the neck should demand a thorough investigation to determine if malignancy is present. Such an increase in size is either produced by hemorrhage into the adenoma or malignant change When hemorrhage develops in a pre-existing adenoma, the patient complains of a sense of pressure often out of proportion to the increase in size of the tumor frequently causing the patient to become more aware of the tumor's presence. Such a tumor is tender and tense Whereas, if the tumor has undergone malignant change, it develops firmness becomes more nodular and fixed than is usual in benign goiters The increase in size of benign goiters is slow but persistent during which time the structures in the neck accommodate themselves to the enlargement A different

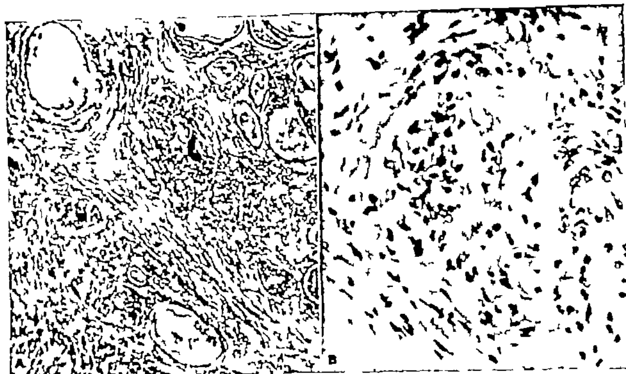


Fig. 532. Riedel's struma. White female 47 years of age has hard tumor thyroid gland of six months duration At first tumor was tender later dyspnea and pressure symptoms.

A. Photomicrograph. Marked infiltration of gland with fibrous tissue. Few acini remaining (Low power)

B Photomicrograph. Infiltration with fibroblasts. Few epithelial cells remain. Patient had been diagnosed as carcinoma of the thyroid.

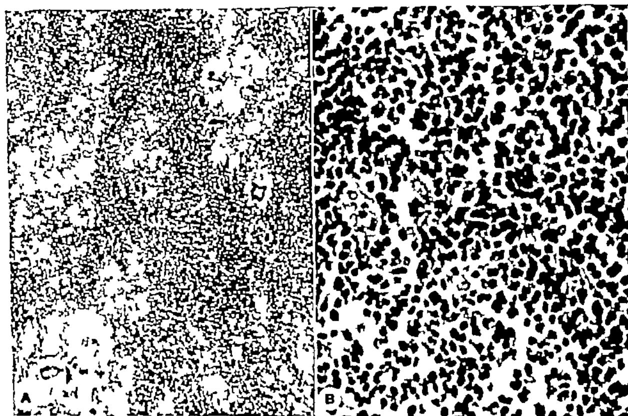


Fig 533 Hashimoto's disease (struma lymphomatosa) Patient white female, aged fifty came with a tumor in right lobe of thyroid of eight months duration. Tumor was firm and measured 4 x 6 cm. Diagnosed clinically as primary carcinoma of thyroid

A. Photomicrograph Marked lymphocytic infiltration Few acini remaining which contain a small amount of colloid. The epithelial cells around the acini simulate the giant cells noted in tuberculosis.

B Marked lymphocytic infiltration with small amount of connective tissue remaining

picture is produced by malignancy in which there is rapid growth with fixation to the surrounding structures The following case history is illustrative.

waiting for thyroidectomy suddenly became cyanotic, dyspneic, and developed evidence of suffocation, suggesting a diagnosis of hemorrhage into a cystic adenoma. A large needle was inserted in the tumor and 150 cc. of bright red blood aspirated There was immediate

Fig 534

L. Drawing of tissues to be removed from patient with carcinoma of the thyroid gland. On right side of the neck is illustrated the removal of the omohyoid, sternomastoid and strap muscles, which are to be taken on the side of the neck that contains the tumo The left side of the drawing shows where the inferior thyroid veins and the internal jugular vein should be ligated divided, and severed where the superior and inferior thyroid arteries should be ligated and divided the lymph node bearing tissue that may be involved and should be removed, along with the structures mentioned in Figures 526, 527 and 528.

The patient a white female sixty years of age was admitted to the hospital with partially substernal adenoma in the right lobe of the thyroid, producing tracheal deviation and some dyspnea There had been a history of rather rapid increase in size during the past three months. The adenoma measured 6 x 7 cm and was rather firm with cystic areas The patient while

improvement in respiration. However the cyst again filled with blood Immediate thyroidectomy was done A bleeding papillomatous area was found in the cyst which showed papillary carcinoma by frozen section. A radical neck dissection was carried out on the side of the cyst The patient was well with no recurrence ten years later

When an adenoma becomes malignant a hard irregularity is noted in its contour When the capsule is invaded, there is fixation to the strap muscles and trachea with definite limitation of movement of the tumor Malignant neoplasms that lie in the posterior area of a lobe, or in the isthmus, may invade the trachea, producing pressure or involve the recurrent laryngeal nerve, with consequent change in the voice to hoarseness, and later fixation of the vocal cord in the cadaveric position A benign tumor seldom produces sufficient pressure on the recurrent laryngeal nerve to produce disturbance of the cord. Other lesions such as aortic aneurysm mitral stenosis metastases from branchiogenic carcinoma, must be eliminated in making the diagnosis of injury or involvement of the recurrent nerve

Thyroid malignancy must be differentiated clinically from lesions such as diffuse chronic, or subacute thyroiditis, Riedel s struma or Hashimoto s disease It is not always possible to make a definite clinical differential diagnosis from these conditions more so if the thyroid has not been the site of previous disease (Fig 532 A and B Fig 533 A and B)

When discrete or bilateral adenomatous goiter increases in size considerable pressure develops since the thyroid is confined by the overlying strap muscles. Such an enlargement may produce definite pressure on the trachea or esophagus resulting in a displacement of these organs and consequent dyspnea and/or dysphagia. Also the tumor, as it enlarges, and being confined by the strap muscles, encounters less resistance downward as the chest, similar to an inverted cone, produces suction on inspiration and draws the tumor towards the superior mediastinum When malignancy develops in an adenoma in such a position or if a malignancy extends down into the superior mediastinum it adds to the symptoms of dyspnea.

The infiltrating or highly malignant lesion will quickly involve the lobe and surrounding structures, with metastases to the regional nodes viscera and osseous system Any type of uncontrolled thyroid cancer may cause death by the local effects of the disease i e., invasion of the trachea and esophagus. Respiratory obstruction from this cause is not relieved to any great degree, or for any reasonable period of time, by tracheostomy The trachea is frequently distorted or invaded by the tumor or the tumor may extend to the structures of the anterior mediastinum When the local lesion in the neck and the node-bearing area is controlled, distant metastases to the osseous system or viscera may be the cause of death The five-year survival rate does not apply well to thyroid malignancy, since the course of the disease may be slow and may not cause death for fifteen or twenty years

Treatment of Thyroid Cancer

The most rational treatment of thyroid malignancy is prevention best accomplished in a rather large percentage of cases by the intelligent handling of discrete adenomas When it is appreciated that probably 80 per cent of thyroid malignancies have their origin in discrete adenomas and that approximately 12.5-20 per cent of such adenomas undergo malignant change, surgical eradication of the adenoma is mandatory The same diligence and intelligent handling should be applied to discrete adenomas of the thyroid as is used in handling apparently benign lesions of the breast. When the lesion is removed and if there is no evidence of blood vessel invasion by frozen section, the tumor can be classified as benign, and no further treatment is indicated.

When a discrete adenoma is removed prophylactically or an adenoma is removed which has been present for a period of time and has shown growth potentialities and if at operation a frozen section demonstrates a malignant adenoma or papillary adenocarcinoma, it is our policy to do a hemithyroidectomy with removal of the isthmus, preservation of the recurrent laryngeal nerve and a radical neck dissection extending up to the digastric muscle (Fig 534) The neck dissection includes removal of the medial half of the sternomastoid muscle the jugular vein, and the fascia containing the lymph nodes. The usual collar incision made for removal of the apparently benign adenoma is elongated up the neck a

the anterior border of the sternomastoid muscle to the level of the hyoid bone

As there are many variabilities in handling thyroid malignancy it is difficult to completely cover all of them. The operability of cancer of the thyroid gland depends on the extent of the primary lesion and the presence or absence of distant metastases. If distant metastases are *not present* the consideration of the extent of

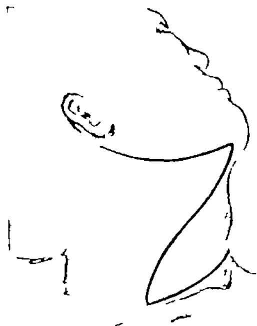


Fig. 535 Z-type incision used for radical removal of thyroid cancer Incision begins below lobe of ear and extends around the neck below the mandible preferably *in a crease to the midline* A second incision, the lazy S vertical drops down to just above the clavicle at the posterior border of the sternomastoid muscle A third or horizontal incision carried from the lower part of the vertical incision across the midline as a collar incision The angles formed by these incisions should be obtuse angles, and not acute angles thereby preventing necrosis of the skin.

the primary lesion is of utmost importance If the lesion has infiltrated the contiguous structures, as the strap muscles, recurrent laryngeal nerve trachea and perhaps the esophagus or has extended beneath the sternum, surgical removal is highly improbable. When the lesion is movable both vertically and horizontally surgical exploration is justifiable Frequently tumors that appear relatively fixed are found to be resectable on exploration If the tumor is only fixed at one or two points, it may be excised, leaving small fragments attached to the trachea or esophagus, and the node-bearing area is resected on the affected side Postoperative irradiation follows in ten to fourteen days. This combination of therapies will frequently give very good results for many years

When there is definite clinical evidence of thyroid malignancy and at operation the lesion is found to involve one lobe and is not firmly fixed to the trachea, even though there are regional metastases, it is our policy to do a hemithyroidectomy with removal of the isthmus and preservation of the recurrent laryngeal nerve and a radical neck dissection

OPERATION FOR RADICAL REMOVAL OF THYROID CANCER AND RADICAL NECK DISSECTION

The patient should be prepared as for all extensive operative procedures on the head and neck. Among such preparation should always be the assurance of an adequate supply of blood from the blood bank.

Anesthesia. For all thyroid operations, intratracheal anesthesia is the anesthesia of choice (1) adequate respiratory exchange is assured at all times. (2) There is no danger of tracheal collapse. (3) The anesthetist is away from the operative field Induction is accomplished by intravenous administration of pentothal sodium. Nitrous oxide oxygen mixture is administered by inhalation.

Technic. The type of skin incision is shown in Figure 535 The skin flaps are dissected widely with the platysma muscles adherent to the skin. The resection should begin laterally with excision of the sternomastoid (Fig 536) muscle In the fastidious woman the outer half of the sternomastoid muscle may be left for better cosmetic results. Ligation of the internal jugular vein should next be done just above the clavicle and just below the mastoid process, reducing the possibility of blood dissemination, since thyroid cancer is prone to invade blood vessels. The attachments of the omohyoid muscle are severed The sternomastoid muscle with the jugular vein and its tributaries from the thyroid gland the superior

middle, and inferior thyroid veins, together with the fascia containing the lymph nodes, are all rolled medially so that the dissection is carried to the thyroid gland behind the enveloping layer of the middle cervical fascia As the tissues are dissected to the lateral border of the thyroid gland the recurrent laryngeal serving if possible, the recurrent laryngeal nerve (Fig 538) The tumor may extend backward to be adherent to the esophagus. If traction is made on the tumor it is possible to kink and injure the wall of the esophagus In most cases, the tumor can be readily dissected free from the esophagus, the dissection is then

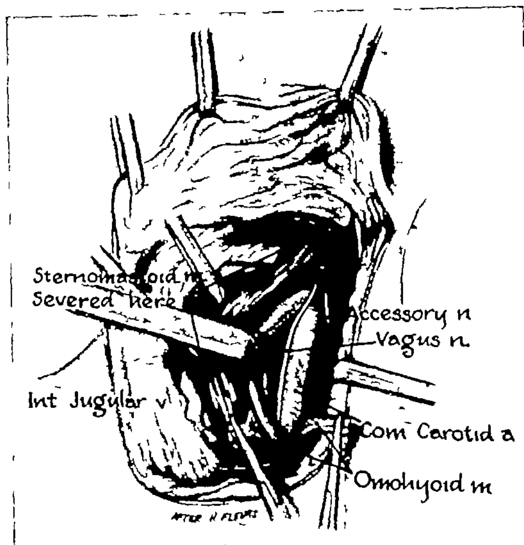


Fig 536. The skin flaps containing the platysma muscle are dissected medially and laterally The resection should begin laterally with excision of the sternomastoid muscle. Ligation of the jugular vein should be done just above the clavicle and just below the mastoid process, reducing the possibility of blood dissemination, since thyroid cancer is prone to invade blood vessels. The attachments of the omohyoid muscle are severed as shown in Figure 534

nerve is dissected out and demonstrated by the method of Lahey The inferior and superior thyroid arteries are ligated to prevent trouble some oozing The strap muscles (Fig 537) are then severed from their upper and lower attachments. The thyroid lobe containing the tumor is then dissected from the trachea removing the isthmus along with the involved lobe and pre carried upward along the esophagus to include the periesophageal nodes. If there is evidence of involvement of the submaxillary nodes, the suprahyoid structures are included with the dissection.

The dissection can be effected with ease if carried out along anatomical lines of cleavage, and rather extensive growths that first may

appear to infiltrate the trachea and esophagus can be removed quite thoroughly. Lesions that have extended from the lower pole of the thyroid and have infiltrated the structures in the superior mediastinum are not removed surgically.

Patients who have had such a thorough operation frequently develop edema of the trachea and esophagus during their immediate postoperative course and associated respiratory difficulty. A tracheostomy is performed at the completion of the operation, thereby preventing a possible later emergency or perhaps

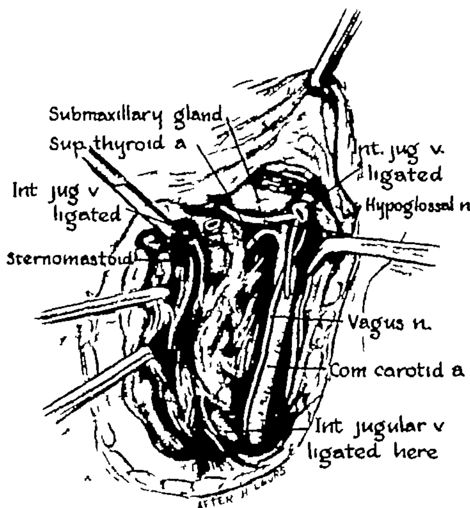


Fig. 537. The internal jugular vein is doubly ligated above and below as indicated and severed. The dissection is carried medially. The common carotid artery and vagus nerve are dissected free and protected. The lymph node-bearing tissue, the sternomastoid muscle, and jugular vein are carried medially with the dissection to the lateral border of the thyroid gland. The superior thyroid artery is doubly ligated at its origin and the inferior thyroid artery as it emerges from behind the internal carotid artery.

It is essential to remove all involved tissue that is adherent to the trachea, if possible leaving the trachea completely bare. This point was stressed by Lahey and will prevent the *possibility of postoperative edema, swelling*, hematoma, so that later irradiation can be carried out with greater ease.

even sudden death from suffocation. The tracheostomy tube should be left in for four or five days and, should postoperative irradiation be deemed advisable, the tube should *remain for a period of five or six weeks. The* silver tracheostomy tube should be removed temporarily during the time of application of the irradiation to prevent irritation from

secondary rays. The tube is then re inserted immediately after the completion of each treatment

IRRADIATION THERAPY OF THYROID CANCER

Irradiation therapy has a definite place as an adjunct to the treatment of operable lesions when the tumor has extended to the contiguous structures or there are regional metastases. Irradiation therapy is begun as soon after surgery as the patient's condition permits, usually within ten days or two weeks A cross-fire method is found preferable using three portals one on each side of the neck and one in the midline care being exercised not to over lap the fields, and directing the rays towards the tumor site Treatments are given daily or three times weekly Each portal receives 200 r units in air per sitting, a total of 2000 r units per portal or a total of 6000 r units to the neck delivered within thirty days Treatment factors are 200 Kv 50 cm T.S.D , filtration, ½ mm. Cu, 1 mm. Al, and appropriate size of portals.

In the event that the case is inoperable the same type of therapy is administered. It has been of definite value in reducing the size of the lesion and holding the regional metastases and the primary tumor in abeyance The same type of therapy has been also of value in the management of a local recurrence If the recurrence is in the regional nodes and there is no evidence of recurrence of the primary lesion,

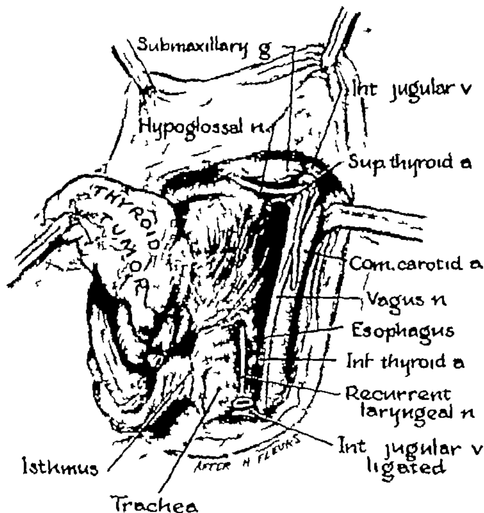


Fig. 538 The dissection is continued medially with protection of the hypoglossal nerve after the lymph node-bearing tissue has been removed in that area the recurrent laryngeal nerve demonstrated and protected. The tumor-containing tissue dissected off of the esophagus and trachea the isthmus, along with the tumor and the pre thyroid muscles, are removed (Figs. 536 to 538 are reproduced through the courtesy of Lahey Hare, and Warren Annals of Surgery December 1940.)

surgical excision should be carried out with postoperative irradiation, as outlined. When the growth is extensive being either primary or recurrent and encroaches upon the trachea and/or esophagus, heavy irradiation by cross-firing from side to side may cause edema of the trachea with consequent obstruction to respiration This complication may be limited or prevented by directing the beam of x rays in an anteroposterior manner on each side of the larynx and trachea so that a minimal amount of the rays actually reaches these organs. Later after the danger of obstruction is passed and the massive growth has receded, the region of the thyroid isthmus may be treated In extreme cases, of course, a tracheostomy may be necessary before beginning irradiation therapy Palliation for months, or years may be anticipated in these advanced tumors, depending upon the histological type of cancer

Radioactive iodine in thyroid cancer In recent years, therapeutic irradiation has been administered by radium, x ray or radioactive isotopes The principle of dosimetry and general biological effects of these therapeutic agents are similar regardless of the particular modality employed

The thyroid has a specific avidity for iodine Consequently iodine can be utilized in the study of both the physiological function of the normal and abnormal gland by using labeled or tracer iodine The diagnosis of certain abnormal disturbances of thyroid function can be determined This also permits a source of radiation directly into the thyroid parenchyma which is of definite value in treating certain thyroid diseases. When ingested into the human body radioactive iodine is concentrated almost entirely in the thyroid gland The amount of irradiation delivered to the thyroid will depend on the dosage administered and the ability of the thyroid tissue to assimilate the administered iodine It has been found by J H Means that the ability of the thyroid to take up iodine and the length of time it will remain in the gland depends upon its functional state

It is quite obvious that if thyroid malignancy and/or the regional or distant metastases assimilate sufficient radioactive isotope and if the tumor is sensitive to irradiation, a valuable method of therapy is available especially in widespread metastases It is estimated that only 15 to 20 per cent of thyroid malignancies have any functional ability; consequently only tumors with such functional ability and/or their metastases, if they also have functional ability will take up and retain enough iodine to enable this form of irradiation to be of value The well-differentiated follicular carcinoma and the malignant adenoma apparently show the greatest ability to assimilate and hold iodine. Their metastases likewise show the same ability Such lesions may be effectively restrained and fibrosed through such a method of intensive irradiation by the radioisotope. The less differentiated carcinomas and their metastases lack the capacity to concentrate iodine They therefore, are not amenable, or less amenable, to effective treatment with radioactive iodine When the histology of a thyroid cancer is known a rather definite evaluation can be made of its ability to be effectively treated by this method of irradiation Tracer doses of radioactive iodine may prove to be of importance in determining and identifying distant metastases in the well differentiated follicular carcinoma and the malignant adenoma

Billroth and von Eiselberg demonstrated, many years ago that following total removal of the thyroid gland for malignancy metastases if present will frequently take on thyroid function to such a degree that a state of hyperthyroidism may develop It may be presumed then, that if a patient having a carcinoma of the thyroid with extensive visceral or osseous metastases has the thyroid gland completely destroyed by radioactive iodine or removed by surgical measures, the metastases present will take on thyroid function and can be better treated with radioactive iodine

This form of irradiation has been used during the past few years in the treatment of a small number of patients with inoperable thyroid malignancy and the resulting metastases with

varying degrees of success. Experimental work is being conducted in centers over the country to evaluate its efficiency Attempts are being made to standardize the dosage and to determine whether there will develop any ill effects to the other systems or organs, such as the kidneys, bone marrow etc. A sufficient period of time will be required to observe patients who have been treated with this modality to evaluate the good and ill effects F H Lahey, speaking before the American Goiter Association at Toronto Canada in May 1948, summed up the problem by saying that the use of radioactive iodine in the treatment of thyroid cancer is a justifiable experiment but at this time is in the experimental stage.

The dosage of a radioactive isotope is expressed in terms of millicures or roentgens of radiation emanated (H B Hunt) The liberation of radiation is associated with the transformation of the unstable radioactive isotope to a stable element above or below the periodic pattern There is a gradual decline in the intensity of the irradiation which follows a definite mathematical pattern for the radioactivity of each particular radioactive isotope The period of activity of the radioactive isotope is usually referred to as its half life which is the period required for reduction of emanated radiation to one-half of its original intensity The two isotopes that have been used therapeutically for the treatment of thyroid malignancy are the twelve-hour isotope, 1–130 and the eight-day isotope 1–131 The 1–130 gives off its total irradiation in three or four days whereas, the 1-131 isotope requires forty five to fifty-five days

The technic of administering tracer doses of radioactive iodine as suggested by Means, is as follows

A tracer dose, 100 microcuries of 1–131 (eight and a half day life) with 100 micrograms of inert sodium iodide as a carrier is made up into 100 cc. water The dose of radioactive isotope is given orally in the morning before breakfast All urine is collected for twenty four and forty-eight hour periods. The radioactivity of the urine in the twenty four and forty eight hour specimens is determined Determinations are also made with a Geiger Müller counter after twelve and twenty four hour periods over the thyroid gland and other areas of the body to determine the amount of iodine assimilated by the thyroid gland the tumor, and metastases if present

This form of therapy has been so extensively discussed in the past two or three years that a word of caution must be advanced as to the safeguarding of workers and others from the unknown effects of this form of irradiation The technic must be worked out for all workers or individuals that are handling radioactive material and treating patients. A technic must be developed that can be used by doctors and technicians to protect them from the material that is being administered to the patient who, himself, acts as a source of irradiation for a given period of time Physicians and technicians must also be protected from the urine specimens that are collected for analysis. A group of rules for health protection in handling radioactive isotopes has been issued by the Atomic Energy Commission Such rules should be followed as the local situation may demand, in any laboratory or clinic that attempts to use such material

Prognosis

The prognosis of carcinoma of the thyroid will be improved by removal of the premalignant lesion, the benign thyroid adenoma, which precedes cancer in 80 per cent of the cases. The second method of improving the prognosis is active treatment of malignancy by surgical measures sufficient to eradicate the parent tumor and the lymph bearing tissue in the drainage area and follow with postoperative irradiation. Third, active treatment of inoperable carcinoma and accessible metastases with irradiation in the form of roentgen rays Fourth to treat the metastases, if functionally active, by radioactive iodine.

A plan for grouping malignant tumors of the thyroid according to the extent of the disease, was suggested by Portmann which is as follows

Group I —Cases without clinical evidence of malignant tumor the tumor being discovered only after microscopical examination and only a few millimeters in diameter

Group II —Cases without clinical evidence of malignant tumor or its presence was suspected *only on the basis of rapid enlargement* of the thyroid or the tumor was discovered at operation and the growth still localized within the thyroid capsule

Group III —Cases with clinical evidence of malignant tumor which had invaded or extended outside the thyroid capsule to the neighboring or distant structures.

In one hundred eighty four cases classified by Portmann as above, Group I had the best prognosis but unfortunately only 15 per cent were in this group Group II had a slightly poorer prognosis than the preceding but only contained 16 per cent of the total number of cases. Sixty-eight per cent (or two-thirds) of this series studied were in the advanced stage when they first consulted the Cleveland Clinic Portmann s results substantiate that of others as well as our own findings, that the best prognosis is obtained when the evidence of malignant tumor was discovered only after microscopic examination and the tumor was only a few millimeters in diameter

TABLE 42

CARCINOMA OF THYROID 5-YEAR SURVIVAL RATE—231 CASES

Percentage of 5 year survival for each group

Lahey Hare and Warren

Adenoma with blood vessel invasion	71%
Papillary cystadenoma—malignant	62%
Papillary adenocarcinoma	80%
Alveolar adenocarcinoma	27%
Small cell carcinoma	22%
Giant cell carcinoma	17%
Fibrosarcoma	33%

In Group II where there was little clinical evidence of malignant tumor and a history of rapid growth of an area of the thyroid gland or the diagnosis was made at operation the prognosis is definitely less than Grade I

In Group III the prognosis is not good as they were in the advanced stage of the disease and were not curable by operation alone

Lahey Hare and Warren report the results (Table 42) of 231 cases of carcinoma of the thyroid, followed over five years Percentages *are given according to the histological classification* of the tumor These patients were treated by combined surgical and irradiation therapy

It will be noted that the best results obtained in this series of cases were in the types of tumor that most frequently develop from a discrete or multiple adenoma. Such tumors are as a group in histological Grades I or II These results are similar to those obtained in carcinoma of the lip or colon when the tumor is of low histological Grade (I or II) and is given adequate treatment early

TUMORS OF THE PARATHYROID GLANDS

(Adenomas and Hyperplasia)

Adenomas and hyperplasia of the parathyroid glands have taken on surgical significance since Felix Mandl of Vienna removed a parathyroid adenoma in 1925 for Von Recklinghausen s disease, or generalized osteitis fibrosa cystica Since that time, extensive investigations have been made on the physiology pathology anatomy and clinical manifestations, along with improvement in the technic necessary for removal of adenomas or hyperplasia Even though this is most important it is not in the scope of this book to go into these various physio-pathological problems in detail. The whole field of hyperparathyroidism has been reviewed recently by Rienhoff who has had extensive experience at the Johns Hopkins Hospital It may be said in passing that the operative management of this disease will require the surgeon in the future to be familiar with the anatomy of the neck for the profession in general is becoming acquainted with symptoms and early diagnosis of hyperparathyroidism and more patients are requiring operation

Anatomy of the Parathyroid Glands

The parathyroid glands occur as four or five yellowish-brown oval bodies, measuring about 7 x 4 x 2 mm., located usually on the lateral, posterolateral or inner surface of the lateral lobes of the thyroid gland. They are associated with the connective tissue capsule or are imbedded in the loose areolar tissue in that vicinity, and are commonly in the area of the thyroid gland supplied by branches of the inferior thyroid artery one on each side associated with the superior posterior branch and one on each side associated with the inferior branch The wide variations in the habitat, especially of the lower parathyroid glands, is stressed in Chapter II on embryology This is important as proved in clinical surgery Parathyroid tissue is seldom if ever, found in thyroid tissue but may be noted in the sulci of the thyroid

Histology

The parathyroid glands are composed of densely packed groups of cells, which are occasionally arranged in cords Two main types of epithelium have been described the principal and the oxyphilic cell The principal cells are supposed to be the more important They have a large clear cytoplasm, practically devoid of granules and a relatively large nucleus. Some observers comment that only this type of cell is found in the human parathyroids until about ten years of age Occasionally in older individuals the principal cells may have an acinar arrangement with colloid-like material in their lumen The principal cell or what is now called 'water-clear cell, is more frequently encountered in parathyroid adenomas, associated with osseous involvement as the predominant part of the clinical picture.

The oxyphilic cells are somewhat larger than the principal cells and contain a granular cytoplasm that stains intensively with acid dye The nucleus is small and deeply staining They may occur singly in groups, continuous masses, or anastomosing columns or even as acini containing colloid however the latter condition is rare The oxyphilic cells are more in evidence in cases of diffuse hyperplasia associated with hyperparathyroidism, in which renal involvement is the predominating clinical finding However both the principal or water clear cell, and oxyphilic cell may be found in the same adenoma when there will be osseous involvement and renal involvement, together with gastrointestinal symptoms.

Abnormal location of the parathyroid glands occurs in about 20 per cent of the cases. In about 10 per cent, one or both of the lower parathyroid glands are located in the mediastinum Another 10 per cent occur away from the thyroid anywhere from the mandible to the clavicle, and from one carotid sheath to the other

Pathological Features of Primary Hyperplasia and Adenomas of the Parathyroid Gland

Hyperparathyroidism is considered by some as a relatively rare disease There is no doubt, however that in the future it will be more frequently encountered as the average physician becomes more cognizant of its manifestations In primary hyperparathyroidism there is hypertrophy and hyperplasia of all four of the glands, or an adenoma involving one or two The gross appearance of the glands when involved by hyperplasia or adenoma may vary considerably as to size and color Their size may range from one to two grams to as much as 120 grams (Norris) and their color from yellow to brownish yellow or dark brown. Their shape also varies with their location. Since parathyroid tissue is soft in consistency, it will conform to a degree with the tissues with which it is associated lying between the thyroid lobes and a rigid trachea, the glands may be flattened However if it is found in loose connective tissue and not compressed, the tendency is to be oval or perhaps bean or pea-shaped.

In hyperparathyroidism as in enlargements of the thyroid gland with toxicity the degree of hyperparathyroidism is not always in direct proportion to the size of the adenoma or hyper

metabolism will have a pronounced effect on the osseous system The osseous system is also the storehouse of phosphorus. If phosphorus is reduced either by loss through the kidneys or by lack of absorption through the gastro-intestinal tract severe demineralization of the bones will result The osseous lesion in hyper parathyroidism (Fig 540 A B) is referred to as osteitis fibrosa generalisata which manifests itself in two forms osteitis fibrosa cystica, with cyst like areas in the bone or the less common form which shows a diffuse decalcification of the osseous system and is referred to as the diffuse osteoporotic type In the latter the bones may develop a rubbery consistency and become very flexible. When demineralization takes place there is histological evidence of osteoclastic and osteoblastic activity The former perhaps removes the calcium the latter attempts to lay down new bone The activity of the osteoblasts increases the alkaline phosphatase noted in hyperparathyroidism. The normal alkaline phosphatase of the blood is from one to four Bodansky units In mod

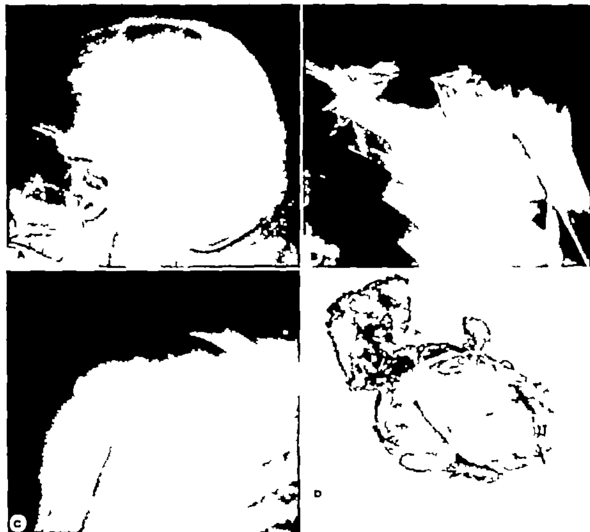


Fig 540 A–D

Fig 540 White female aged 54 years Arthritic pains, 10 years Pathological fracture neck of left humerus. Blood serum calcium 15 mg per cent phosphorus 2 mg. per cent alkaline phosphatase 55 Bodansky units Urine Sulkowitch s test 4 plus.

A Roentgenogram skull Marked demineralization

B Roentgenogram of left shoulder cystic changes in scapula and head of left humerus.

C. Roentgenogram of right shoulder cystic changes. head of right humerus.

D Enucleated parathyroid adenoma weight 35 gm

erately advanced cases of hyperparathyroidism, it is not unusual to find alkaline phosphatase values of 18–26 Bodansky units. Both osteoclasts and osteoblasts are supposed reticular cells that form osteoclasts or osteoblasts. Multiple cysts may develop in the areas of fibrosis. Such cysts will enlarge and become multilocular. Other areas may show a marked

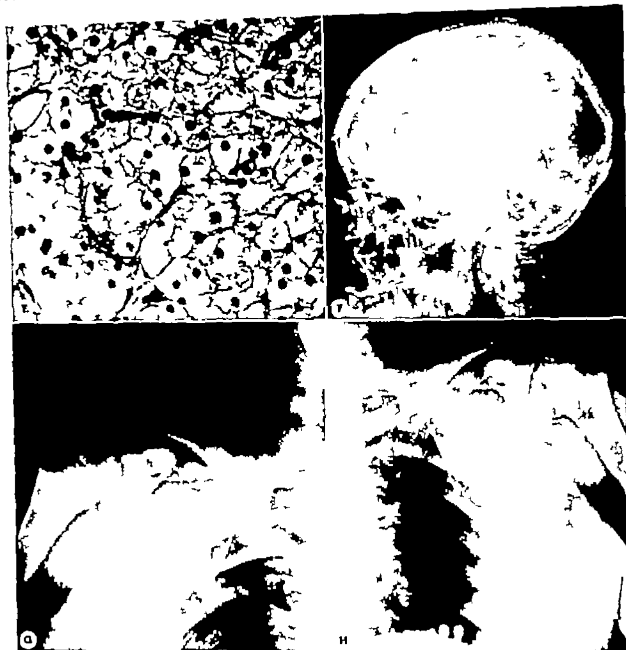


Fig. 540 (E–H)

E. Photomicrograph showing large clear wasserheller type cells, forming acini. Cells have large clear cytoplasm with small hyperchromatic nuclei. Stroma sparse.

F. Roentgenogram after enucleation of parathyroid adenoma showing recalcification of skull.

G. Recalcification of right humerus.

H. Recalcification of left humerus. Blood serum phosphorus, calcium and alkaline phosphatase returned to normal. (Courtesy Robert C. Sheppard, University Hospital.)

to be derived from the reticular cells of bone marrow. When demineralization takes place there is an associated marked fibrosis, thought by Rienhoff to represent proliferation of the proliferation of the osteoclasts to such a degree that osteoclastomas are formed (benign tumors of bone tissue with giant cells). This picture of advanced stage with cysts and tumors is

called Von Recklinghausen's disease or osteitis fibrosa cystica

RENAL COMPLICATIONS

The commonest complication in hyperparathyroidism, as noted by Cope in 1944 is precipitation of calcium in the urinary tract Keating and Cook of the Mayo Clinic, in 1945 *observed that 67 per cent of the patients had* undergone one or more operations for renal calculi without a diagnosis of hyperparathyroidism being made (Fig 541 A B)

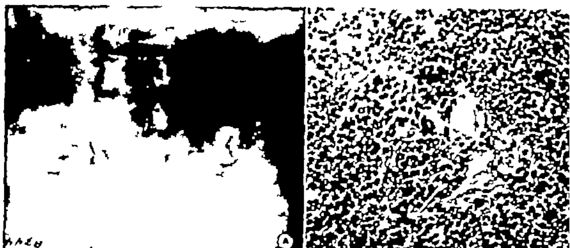


Fig. 541 Colored female aged 49 arthritic pain. Vague gastrointestinal symptoms Severe pain over bo areas, 18 months' duration. X ray examination of osseous system only slight demineralization of skull. B. Staghorn calculi. Blood serum calcium 13.2 mg per cent, phosphorus 2 mg per cent alkaline phosphat Bodansky units. Urine Sulkowitch test 4 plus Enucleation of parathyroid adenoma 2 x 2 x 3 cm Postop blood serum calcium 9 mg per cent, phosphorus 3 9 mg per cent alkaline phosphatase 4 Bodansky units. Sulkowitch test negative.

A. Roentgenogram, bilateral, staghorn renal calculi.

B Photomicrograph showing large cells, some attempting to form acini, others occurring in strands. Cel tain small amount of cytoplasm large dark staining nuclei Oxyphilic or chief cell type of adenoma.

LABORATORY FINDINGS

The laboratory findings in hyperparathyroidism are related to calcium and phosphorus metabolism. Hypercalcemia is increased from the physiological normal of 9.5 to 10.5 mg per cent to 12.5 to 13 mg per cent in mild cases, and in severe cases up *to 18 or 20 mg* per cent On the contrary the phosphorus level in the *blood* is decreased from the physiological normal of 3.5 to 4 mg per cent down to 1.5 to 2 mg per cent varying with the severity of the disease In addition especially in the osseous type there is an increase in the alkaline phosphatase level in the blood from the physiological normal of 1 to 4 Bodansky unit 6 or 8 Bodansky *units in mild cases,* 25 or 30 Bodansky units in severe cases. is an increased excretion of calcium in the as noted by the Sulkowitch test

DIFFERENTIAL DIAGNOSIS

The points of differential diagnosis b hyperparathyroidism and other com encountered bone diseases have been marized by *Albright et al (1938) It is* remembered that in the early stages disease there are no definite sympto clinical manifestations. The various o lesions that should be differentiated from produced by hyperparathyroidism a *follows as was suggested by Albrigh* al (Table 43)

Senile osteoporosis frequently mimic mild form of osteoporotic type of hyper thyroidism In both conditions there is ra tion of the bones, probably produced b overactivity of the osteoclastic cells an underactivity of the osteoblastic cells so bone is absorbed faster than it is laid d *There are bone pains and demineraliza*

TABLE 43

POINTS IN DIFFERENTIAL DIAGNOSIS BETWEEN HYPERPARATHYROIDISM AND OTHER BONE DISEASES

Disease	Symptoms	Differential Points as Regards		Serum		Plasma	
		Roentgen Studies	Biopsy	Calcium	Phosphorus	Phosphatase	Miscellaneous
Hyperparathyroidism with bone involvement	Bone pain deformity fracture tumor polyuria those related to stones	Increased radiability generalized deformity cysts tumors fractures stones	Rarefied bone fibrosis of marrow osteoclasts +++ osteoid tissue only slightly increased osteoblasts	High	Low	High	All age groups
Senile" osteoporosis	No bone tumor polyuria or stones	No cysts, tumors or stones	No fibrosis of marrow osteoclasts normal osteoid tissue normal or decreased osteoblasts decreased	Normal or low	Normal	Normal	
Paget's disease	Bones enlarged no polyuria stones infrequent	Polyostotic but not generalized bones hypertrophied, e.g. thickened skull	May occasionally be difficult or impossible to differentiate	Normal or sl. high	Normal or sl. high	Very high	Runs in families predilection for weight bearing bones seldom seen under 40 arteriosclerosis +++
Osteomalacia	No bone tumor polyuria or stones	No tumors or stones, bending deformities +++	Osteoid tissue +++	Normal or low	Low	High	Practically absent in this country except with fatty diarrhea
Solitary' cysts	Confined to cysts	No generalized changes cysts may be multiple	Cannot differentiate if taken from lesion	Normal	Normal	Normal	
Solitary benign giant-cell tumor	Confined to tumor	No generalized changes	Cannot differentiate if taken from lesion	Normal	Normal	Normal	
Osteogenesis imperfecta	Fractures +++ no bone tumor polyuria or stones	Cysts rare no tumors or stones	No fibrosis of marrow osteoclasts normal	Normal	Normal	Normal or very slightly elevated	Hereditary often coupled with blue sclerae and deafness improves after cessation of growth

TABLE 43—*Concluded*

DISEASE	SYMPTOMS	DIFFERENTIAL POINTS AS REGARDS		SERUM		PLASMA	
		Roentgen Studies	Biopsy	Calcium	Phosphorus	Phosphatase	Miscellaneous
Multiple myeloma	Can cause same bone symptoms and renal symptoms	Can be almost indistinguishable	Tumor tissue	Normal or high	Normal or high	Normal	
Metastatic malignancy	—	Bones not involved, normal seldom affects bones of forearms and lower legs	Tumor tissue	Normal	Normal	?	? Primary focus

with a tendency to deformities and fractures. The plasma phosphatase calcium and phosphorus determinations in the senile osteoporosis are normal Usually complete metabolic studies are sufficient to make a differential diagnosis

Solitary cysts. Solitary cysts are not infrequently encountered. There is usually normal skeleton elsewhere and a normal serum content of calcium, phosphorus and phosphatase Multiple cysts strongly suggest hyperparathyroidism

Multiple myeloma. X ray studies of the skeletal system may demonstrate lesions simulating those of hyperparathyroidism After multiple myeloma is well established the various flat bones and spine the long bones and pelvic bones may show numerous irregular punched-out areas of diminished density Bence Jones proteinuria is present in about 70 per cent of cases of multiple myeloma There may be a rise in blood calcium level whereas the blood phosphorus and alkaline phosphatase levels are usually normal Renal changes are frequently encountered in the later stages of multiple myeloma A biopsy will also serve to differentiate between multiple myeloma and hyperparathyroidism

Metastatic malignancy is frequently encountered in the osseous system (from the breast thyroid bronchus, prostate and hypernephroma) Metastatic malignancy is seldom noted in the bones below the knees and elbows. We have noted some cases that simulated hyperparathyroidism when there was a metastatic lesion from breast carcinoma. These patients had hypercalcemia and an elevated alkaline phosphatase. However the serum phosphorus was within normal limits. A biopsy of the involved area, if necessary will establish the correct diagnosis.

Osteogenesis imperfecta may simulate osseous changes of hyperparathyroidism in that both are a generalized bone disease and multiple fractures may occur in both The blood calcium, phosphorus, and alkaline phosphatase are within normal in osteogenesis imperfecta

Paget s disease was formerly considered a type of hyperparathyroidism Roentgenological examination will usually differentiate the two diseases Paget s disease occurs more frequently in the flat bones producing a motheaten appearance and thickening of the bone The skull and the sacrum are mostly involved There is coarse trabeculation of the bones affected by Paget s disease but seldom, if ever seen in osseous changes of hyperparathyroidism. The calcium phosphorus, and phosphatase blood levels are within normal limits Renal involvement in the form of renal calculi is not frequent in Paget s disease In some stages a biopsy from an area of bone in Paget s disease

is difficult to distinguish from that of hyper parathyroidism.

Treatment

Intratracheal anesthesia is essential to effectively carry out whatever surgical procedure is necessary Adequate blood from the blood bank should be on hand if the dissection is prolonged which is frequent

The operative technic is similar to that employed for thyroidectomy A generous curved incision is made one fingerbreadth above the clavicle. The skin flaps and platysma muscle are well reflected the upper flap being carried to the cricoid cartilage The ribbon muscles namely the sternothyroid and sternohyoid, should be divided to permit better exposure and greater ease of careful dissection The lateral thyroid veins on each side are ligated and severed The recurrent laryngeal nerve is demonstrated by the method of Lahey Careful hemostasis must be followed meticulously throughout the operation, as bleeding or hematoma may obscure the identification of normal parathyroid or hyperplastic glands, or small adenoma of the parathyroid a lymph node, or damaged surrounding fat tissue. Examination of the region of the distribution of the inferior thyroid artery is imperative. A search for the upper glands should be conducted first When it is appreciated that the upper glands exist in a rather limited area around the upper part of the thyroid but if enlarged may be displaced downward toward the posterior mediastinum they are rather easy to find First the upper gland on the side should be identified

It was shown by Cope and others that the lower glands sometimes called the parathymus glands, when normal were found distributed over a wide area from the larynx to the anterior mediastinum but when enlarged they may be found in the posterior mediastinum also

Usually if the upper or lower glands are in their normal habitat a small vascular pedicle is found extending from the inferior thyroid artery but occasionally the upper glands are supplied from the superior thyroid artery Not infrequently the glands may be found along the anastomotic branches of the inferior and superior thyroid arteries. The parathyroid glands are most easily found by tracing the vascular pedicle from its origin from the inferior or superior thyroid arteries. The upper glands may lie on the medial, posterior or postlateral surfaces of the thyroid gland If they are not readily identified the superior laryngeal nerves may be exposed. In searching for the upper glands, the dissection should be carried to the upper border of the larynx and the areolar tissue in the neck, as far lateral as the carotid sheath. All contours of the neck and sulci of the thyroid should be carefully examined for hyperplastic glands or a small adenoma. It is necessary to explore the tracheo-esophageal angle and the region behind the esophagus. In the event that a gland occurs in the region between the trachea and esophagus or behind the esophagus, there will be a vascular pedicle extending from one of the thyroid vessels to it The dissection can be carried down to the posterior-superior mediastinum on either side On the left, care should be exercised not to injure the thoracic duct

Thymic rests are not infrequently encountered in the neck as well as the mediastinum, and are due to remnants of tissue being dropped off as the thymus made its descent from the primordium to the mediastinum. As pointed out by Cope these rests are pieces of the uppermost part of the developing thymus and that portion with which the parathyroids are closely associated. Consequently parathyroid tissue may lie within their capsule Also, not infrequently a tongue of thymic tissue will extend from the isthmus of the thyroid to the normal thymic tissue within the anterior mediastinum Hyperparathyroid adenomas have been found and removed within the capsule of such a tongue of thymic tissue.

It may be stressed again that the vascular pedicle is frequently an asset in locating misplaced parathyroid tissue. Rienhoff and Walton have noted the presence of parathyroid adenoma in the posterior mediastinum where embryologically no parathyroid tissue should

exist Respiratory movements account for the descent of parathyroid tissue into the posterior mediastinum In each case there was a long vascular pedicle leading from the parent thyroid artery to the adenoma It is their impression that the vascular supply of the abnormal parathyroid tissue is *the point* which determines whether the latter has been displaced mechanically or embryologically In the event that the parathyroid tissue has been displaced during embryological development the circulation is supplied locally rather than from the thyroid arteries

When the adenoma is not found in the neck the anterior mediastinum must be explored, a surgical procedure not discussed in this book but adequately covered in the works of Rienhoff Cope Churchill Norris, and others.

When once found the parathyroid adenoma or hyperplastic gland is easily removed. If a very large tumor is present and there is not much evidence of other parathyroid tissue, an amount equal to a normal parathyroid gland should be left or in other words, a subtotal resection performed If the blood supply has been disturbed the desired amount of gland tissue to be left is implanted in the sternomastoid muscle This was done by Clute and Cattell who found it necessary to remove occasionally the parathyroid glands in operating for carcinoma of the thyroid and by re-implanting them tetany was avoided

The closure of the wound is the same as that for thyroidectomy

POSTOPERATIVE TREATMENT

Careful observation of the patient for tetany is necessary following removal of parathyroid adenoma or diffuse hyperplastic gland Evidences of tetany are tingling of the hands and feet the feeling of jitterness twitchings of the hands and fingers, a positive Chvostek sign and hyperactive reflexes due to hypocalcemia This hypocalcemia should be anticipated and *prevented by the administration postoperatively* of large doses of calcium, either by mouth or intravenously along with adequate vitamin D by mouth If evidence of tetany develops, parathormone should be administered. Daily determinations of the blood calcium, phosphorus and phosphatase indicate the early signs of the development of tetany As was mentioned previously frequently when the hypercalcemia is reduced rapidly by the removal of an active parathyroid tumor the preoperative blood calcium of 15 16, or 17 mg per cent will drop within forty-eight hours to 8 or 9 mg per cent unless the body is supported by calcium therapy along with vitamin D and probably A T 10 (active parathormone extract) 10 units three times daily

There is likelihood of tetany developing in the recalcification period of several months, when the osseous system is involved. The phosphatase level which is elevated preoperatively may fall immediately after operation but begins to ascend within a week or two and remain slightly elevated during the time that recalcification of the osseous system takes place Preoperatively the phosphorus level is low and may also descend to a lower level during the first forty-eight to seventy two hours following operation, but then begins to rise and returns to normal within a period of several weeks.

PRIMARY TUMORS OF THE NERVES OF THE NECK

Primary nerve tumors of the neck are rare. Their characteristics are similar to nerve trunk and ganglion tumors found in other regions of the body (Neoplasms containing spindle cells and fibrous tissue are referred to as neurofibromas, those having origin in ganglion cells are called neurogangliomas) both are to be differentiated from Von Recklinghausen s disease (Fig. 542 A–C)

Neurofibromas occur deep in the neck and seldom involve the skin They frequently develop in childhood as slowly growing ovoid firm tumors deeply located and are immobile vertically and horizontally On section the *tumor is grayish white in color and may be* associated with a cervical cranial or sympathetic nerve trunk or ganglion After they have grown to a large size often it is impossible



Fig 542 Neurofibroma right side of neck

A. White female, 42 years of age developed tumor below the angle of the mandible 8 years previously Tumor has gradually increased in size. Examination revealed tumor four centimeters in diameter only slightly movable vertically and horizontally Rubbery in consistency Operation total excision of tumor that had origin in cervical nerve.

B Photomicrograph low and high power neurofibroma.

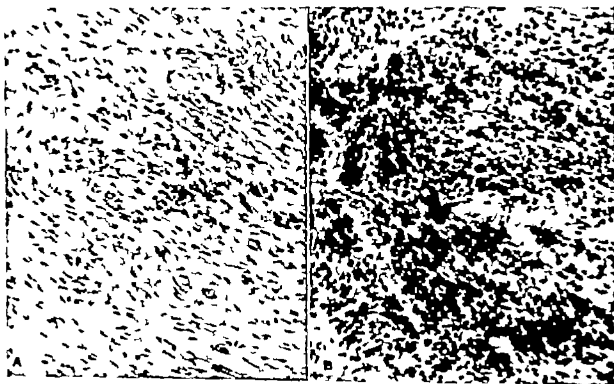


Fig. 543 Neurofibroma occurring in posterior triangle of neck of female, 26 years of age tumor had been present 14 years and recently had shown growth.

A. Low power photomicrograph spindle cells with dark-staining nuclei and edematous connective tissue.

B Photomicrograph high power showing spindle and round cells with dark-staining nuclei occurring in strands and masses. The connective tissue is sparse.

to determine their site of origin. They are more commonly encountered in the mid neck, but may be located anywhere along the distribution of the nerves. Neurogangliomas grow more rapidly are soft in consistency and are more apt to develop into sarcomas Plexiform types may develop

(These fibroneuromas are to be differentiated from Von Recklinghausen s disease which has general distribution over the body with skin manifestations a disturbed pigmentation known as café-au lait spots.)

The treatment is thorough surgical excision. An incision should be made over the tumor and the neoplasm thoroughly dissected out with all its ramifications. They are unresponsive to irradiation therapy

The resumé of the case history of a five year old male is given The patient s parents observed a swelling under the right ear when the child was three and a half years old which was thought to be caused by mumps The mass increased in size slowly for about one year when a second lump appeared in the vicinity of the first Elsewhere inadequate biopsy was reported as lymphoma X ray therapy was given with no effect on the tumor When first seen in our office after onset a tumor measuring 3.5 cm in diameter was present in the upper part of the posterior triangle of the neck on the right side in the region of the tail of the parotid gland. There were several other small nodules varying from one to two centimeters in diameter around the larger tumor No lymph nodes were palpable in the neck and no other nodules observed over the body There were no pigmented skin areas, such as seen in Von Recklinghausen s disease, Careful general examination and blood studies revealed no generalized disease and no blood dyscrasia

At operation skin flaps on the right side of the neck were raised exposing the neck structures from clavicle to mandible and from mid line in front to midline in back Many round and oval tumors were scattered throughout the neck but not distributed along the course of any cervical or cranial nerve The lower half of the parotid gland was full of tumor so that a portion of the facial nerve had to be sacrificed After a long and tedious dissection the upper neck was cleared of tumor Frozen section diagnosis of low grade neurogenic sarcoma or neurofibroma of the plexiform type was later confirmed by permanent section as plexiform neuroma

Two other operations were required to remove all of the tumors scattered in the lower neck and from the sympathetic chain posterior to the carotid sheath Tiny neoplasms, some the size of a grain of wheat studded the sympathetic chain up to the base of the skull It was evident that the plexiform neuroma had followed the distribution of the sympathetic nerves throughout the neck.

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Chapter XVIII

TUMORS PRIMARY IN THE LYMPH TISSUES OF THE HEAD AND NECK

PRIMARY LYMPHOMAS

Frequently it is necessary to differentiate between primary malignant lymphomas and constitutional diseases (leukemias) that also involve the lymph nodes. Lesions as protean as the lymphomas mimic not only one another but constitutional diseases and chronic and acute local inflammatory processes of the lymph nodes The clinical picture often is as important in making a correct diagnosis as the histological examination as the latter may change from time to time and the pathologist can pass only on material submitted to him at a given stage of the disease Time frequently is required to differentiate between lesions to determine whether primarily local or constitutional In the latter generalized symptoms may become evident at a later date. Inflammatory lesions frequently resemble malignant lymphomas consequently, it is necessary to determine whether the lesion is neoplastic, constitutional, or inflammatory

Since certain of the lymphomas of the neck have responded favorably to irradiation, there is a tendency for some clinicians to refer for irradiation therapy all lesions of the neck without taking the trouble to make an exact diagnosis This is so unscientific as to require no discussion All tumors of the neck should have a histological examination of adequate material removed It is therefore imperative that representative material be submitted to the pathologist for study An entire node should be removed when possible and one that is representative of the group and not a small one simply because of its accessibility

The primary lymphomas may be classified as follows

1 Hodgkin s granuloma (disease)
2 Lymphosarcoma
3 Reticulum cell sarcoma
4 Giant follicle lymphoma
5 Lympho-epithelioma

Hodgkin's Granuloma (Disease)

Sir Thomas Hodgkin is credited with reporting in 1832 several patients with constitutional manifestations and enlargement of the cervical lymph nodes All patients in this group succumbed to the disease. Kundart, a pupil of Hodgkin, in 1865, made a further study of this clinical syndrome and was the first according to legend, to differentiate it from lymphosarcoma. In addition, he referred to it as Hodgkin s disease Sternberg and Reed (1898) extensively studied patients with the clinical syndrome of Hodgkin's disease and reviewed some of the material presented by Hodgkin. They found a large giant cell was consistently present in the histological specimen thereby elaborating on the pathology of the disease. Since that time, the large multinucleated cell has been referred to as the "Reed-Sternberg" giant cell.

INCIDENCE AND ETIOLOGY

Hodgkin s disease is not common Symmers and Barron reported 0 24 per cent of cases among several thousand autopsies from a general hospital Dorn (1949) reports 2163 deaths from Hodgkin s disease in the United States in 1947 The disease occurs more frequently between fifteen and forty years of age a few cases have been reported under one year of age Males are involved about twice as often as females in the younger age group the ratio between males and females is about five to one The disease may occur in all races climates and countries It seems that males in good physical condition are more frequently involved than the asthenic type

Hodgkin s disease has been considered to be an infection neoplasm, a constitutional disease it may mimic any of these A number of workers have thought that it was an infectious granuloma In 1900 Frankiel and Much described an organism associated with this lymphogranuloma Later Bunting and Yates grew a pure culture of diphtheroid bacillus from a Hodgkin s lesion Sternberg contended Hodgkin s disease was atypical tuberculosis Ewing also thought that it was of tuberculous origin Investigators have made an autogenous vaccine from organisms cultured from Hodgkin s disease lymph nodes, but no beneficial therapeutic results were obtained from its administration It is deduced at this time that Hodgkin s disease and tuberculosis are separate and distinct and have no relation except that a patient with chronic Hodgkin s disease naturally has lower vitality and would be a more likely candidate for tuberculosis

To those that contend that Hodgkin s disease is a true neoplasm it must be remembered that frequently several nodes may develop in different locations at approximately the same time with a variety of cells As a rule tumors do not have a multiple origin but only have unicentric origin (Hertzler) Hodgkin s disease may simulate a sarcoma at some period during its growth and development later it may have all the appearance of a granuloma. Since there are multicellular and multicentric points of origin with some nodes showing growth others central necrosis while others fibrosis, would lend support to its being an infectious granuloma (Hertzler) Occasional cases are observed in which the disease process invades its capsule and the surrounding tissue suggesting at least clinically lymphosarcoma. Such cases not infrequently terminate as a typical Hodgkin s disease

PATHOLOGY AND PATHOGENESIS

At times, the first evidence of the disease is an enlarged lymph node usually discrete measuring 1 2 or 3 cm in diameter in the neck The nodes first are movable smooth and rubbery in consistency and as they enlarge and the disease progresses, other nodes become involved and matted together to form large nodular masses They seldom break down and fuse together as is noted in tuberculosis.

Table 44 indicates the sites of origin in a group of 241 cases reported by Slaughter & Craver

These observers noted that the first evidence of the disease was enlarged lymph nodes in the cervical area in two-thirds of the cases. Goldman reporting a large series in 1940 stated that cervical lymphadenopathy was the presenting symptom in 79 per cent

TABLE 44

SITES OF ORIGIN IN A GROUP OF 241 CASES REPORTED BY SLAUGHTER D P AND CRAVER, L F AMERICAN JOURNAL OF ROENTGENOLOGY 1942

ENLARGED LYMPH NODES	NO. CASES	PER CENT
Left cervical	99	37 5
Right cervical area	55	20 8
Both sides of neck	19	6 8
Mediastinum	18	6 0
Right axilla	17	6 5
Left axilla	14	
Inguinal	19	
	——	
	241	

When the lesion develops in the neck it may remain solitary for varying periods of time or the adjacent nodes may become involved producing a nodular bulge On palpation the various nodes can be felt distinctly (Fig 544 A, B C) Both sides of the neck may be simultaneously involved, the lesions extending to such a degree that the patient presents the "horse collar type of neck (Fig 545) When the nodes first occur around the face and neck as the submaxillary gland area and are associated with infection in the mouth they may be attributed to the infection (Fig 546 A and B) The primary lesion may be a node in the substance of the cheek producing a diffuse enlargement of the face on the affected side (Fig 547 A B) When the nodes are primary in the head and neck other areas of the body should be meticulously investigated as the epitrochlea areas axillas groins liver and spleen and

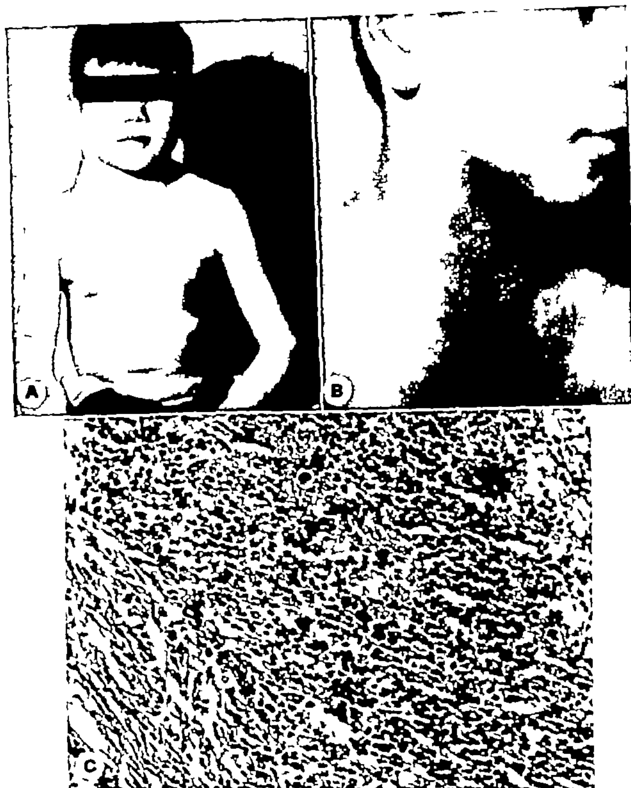


Fig 544

A. Hodgkin's disease in an 8-year-old child Bosselated swelling right side of the neck 10 weeks duration Lymph nodes feel like potatoes in a sack

B Results following adequate irradiation to enlarged nodes.

C Photomicrograph of lymph nodes showing moderate connective tissue reaction Variability in size of cells. Large multinucleated cells, eosinophiles and lymphocytes

roentgenogram of the chest In some forms of the disease nodes appear simultaneously over many areas of the body (Fig 548)

When a node is removed for biopsy, as a rule it is found to be encapsulated and only attached at the hilus by the blood vessels. The

cut surface is shiny, pale pink, and contains tiny nodules. The center of some nodes may show liquefaction and necrosis.

HISTOLOGY

The histological picture in the very early stages shows the normal architecture of the node consistent with chronic inflammatory reaction. There is an increase in the lymphocytes with moderate proliferation of the reticulo-endothelial cells. Later the normal node archi-

Fig. 545. Hodgkin's disease involving both sides of the neck simultaneously. Patient presents a horse-collar type of neck.

tecture is destroyed. Large multinucleated giant cells, Reed-Sternberg cells, may be present in variable numbers and are pathognomonic of the disease. There is also an increase in the eosinophiles, which may be detected better by special stains. The Reed-Sternberg cells may be present in profusion in one stage of the disease and practically absent in another, or may be present in one node and almost absent in another neighboring node. The Reed-Sternberg cells vary in size and are large with clear cytoplasm with a hyperchromatic irregular or horse-shoe shaped nuclei. The etiology of the Reed-Sternberg cell is uncertain but its presence is frequently necessary for a diagnosis of Hodgkin's disease. These cells are

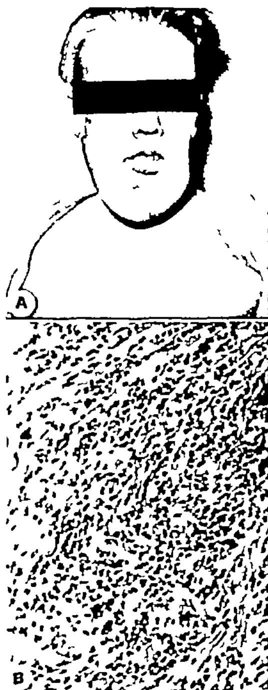


Fig. 546.

A. Patient developed swelling under submental area following an abscessed incisor tooth 3 months previously.

B. Photomicrograph of biopsy. Moderate fibrous connective tissue reaction. Reed-Sternberg multinucleated cells, eosinophiles, lymphocytes.

found in all cases of Hodgkin's disease at one time or another. As the disease progresses and more nodes become involved, there is evidence

of a dense fibrosis due to proliferation of fibroblasts The amount of fibrosis also varies with the amount of irradiation therapy received which increases the production of fibrosis in Hodgkin's disease, more so than in the other types of lymphomas Irradiation also produces



Fig. 547

A. Patient, white male, developed swelling in substance of the left cheek also later a small lymph node developed over the left temple.
B Photomicrograph of biopsy lymph node from left cheek shows chronic inflammatory tissue reaction No Reed-Sternberg cells. Later biopsy showed numerous Reed-Sternberg cells, eosinophiles, and moderate fibrous connective tissue.

moderate fibrosis in lymphosarcomas only a slight amount in lymphatic leukemia, and practically none in normal nodes (Ward and Covington)

Ewing classifies Hodgkin s disease into two types (1) Hodgkin s granuloma as an infectious process with an inflammatory reaction predominating and (2) Hodgkin's sarcoma. The former has a more benign course the nodes are slower in developing constitutional symptoms are late in manifesting themselves and histological examination of the lymph nodes reveals only occasionally Reed cells with rather marked fibrosis. The latter type, or Hodgkin's sarcoma, is a true tumor resembling the other lymphoblastomas The histological picture in the Hodgkin's sarcoma, according to Ewing, shows the predominating cell to be of moderate



Fig. 548 Hodgkin s disease developing in lymph nodes simultaneously over many areas of the body Supraclavicular upper cervical, axillary and groin lymph nodes involved.

size resembling an endothelioma or lymphosarcoma cell There are occasional Reed cells, eosinophiles, and an increase in the lymphocytes, reticulo-endothelial hyperplasia, and fibrosis It manifests itself clinically as a very malignant, rapidly recurring tumor with perhaps only one or a few areas of involved nodes. It is his opinion that mediastinal Hodgkin s disease is a representative example.

CLINICAL BEHAVIOR

The disease begins more frequently in the cervical lymph nodes and may be unilateral or bilateral, but other areas may be involved first. Since this is a treatise on tumors of the head and neck our discussion of Hodgkin's disease will be limited to involvement in this region. As the disease progresses nodes in other parts

of the body become invaded there is an associated secondary anemia, and an elevated temperature the latter symptoms developing according to the rapidity with which the disease progresses.

Skin manifestations may be present early or late and represented by an exfoliative dermatitis with pruritis (1%) The etiology of the dermatitis is obscure it is thought by some to be caused by obstruction of the fine lymphatic channels of the skin. Pruritis, as a rule is not severe and may disappear temporarily following irradiation of nodes, only to reappear when other nodes become involved or if the initial nodes again enlarge The dermatitis may be generalized (Fig 549) or may be localized to a part of the trunk or the extremities. In the leukemias an intractable pruritis is common and produces more of a problem than in Hodgkin s disease



Fig. 549 Dermatitis, associated with Hodgkin s disease. Exfoliating dermatitis with severe pruritis. Probably represents involvement of fine lymphatic channels of the skin.

Elevation of temperature occurs sometime during the course of illness and may be rather constant during the latter stages. A remittent type of fever was described by Pell in 1887 and Ebstein in 1889 They noted that a patient with Hodgkin s disease may begin to develop an elevated temperature steadily rising higher in the afternoon than in the morning for a period of several days and then fall by lysis in from four to six days. After varying periods of time from several days to months, similar bouts of fever recur the peak seldom being above 102° This type of fever is known as Pel-Epstein fever curve and is only noted in Hodgkin s disease and in none of the other lymphomas On the other hand the patient may develop a low grade continuous fever that remains during the latter months of the disease. The cause of the elevated temperature has never been explained The varying theories are that it is produced by absorption from broken-down lesions, or that it is due to absorption of bacterial toxins from an infection.

Patients affected with Hodgkin s disease after it has developed to a degree that a positive diagnosis is obvious are chronically ill. The enlarging nodes in the neck may produce pressure on the trachea and esophagus, causing disturbance in swallowing and breathing Occasionally upper cervical nodes become large enough to produce pressure on and bulging of the pharynx simulating lympho-epithelioma. As the disease progresses, secondary anemia with associated elevated temperature, malaise, and anorexia, ensues. These symptoms are more characteristic of Hodgkin s disease than of the other malignant lymphomas.

Hematological examination is of value in differentiating Hodgkin s disease from the leukemias. In Hodgkin s disease there may be a slight eosinophilia (4–6 per cent) and a mild leukocytosis of 10,000–12,000 WBC/cu. mm., with 70–75 per cent polymorphonuclear leukocytes and 20 per cent small lymphocytes with 3 or 4 per cent monocytes. As the disease progresses, leukopenia is common. The white blood cell count may decrease to 2000 or 3000 per cu. mm. During an exacerbation of the disease with a paroxysm of fever there may be a mild leukocytosis. If very high white blood cell

counts are present, differential blood studies are necessary to rule out leukemia as stressed by Warthin. A secondary anemia develops during the latter stages of the disease, which is quite unresponsive to such therapy as liver, iron, or transfusions

It is commonly accepted that the enlarged lymph nodes of Hodgkin's disease are responsive to irradiation and this therapeutic modality has been recommended by some clinicians as a diagnostic measure to differentiate probable cervical tuberculous lymphadenitis and other diseases. This is mentioned only to be condemned as unscientific and inconclusive. Accurate diagnosis can be made by a careful history, physical examination, and adequate biopsy

DIFFERENTIAL DIAGNOSIS

In most cases a diagnosis of Hodgkin's disease may be made with certainty following a careful history, examination, and biopsy of a representative lymph node. Hodgkin's disease occurs more frequently in the male and seems to have a predilection for individuals in good health The primary node or nodes may develop on one or both sides of the neck simultaneously Early, they are movable, nontender elastic in consistency, and do not have the stony-hardness of metastatic carcinoma They develop more frequently in the posterior triangle of the neck and in the supraclavicular area. A meticulous examination of all lymph node-bearing regions of the body may also reveal involvement

Tuberculous lymphadenopathy Tuberculosis may involve either single or multiple nodes more frequently occurring unilaterally Tuberculous cervical lymphadenitis may be present in one of two types a chronic slowly growing and a more rapidly progressing type. In the chronic cases the nodes are small and multiple and distributed throughout one or both sides of the neck. The nodes are discrete firm and freely movable

In the more rapidly progressing type, the nodes are usually fewer in number and attain a larger size Necrosis of the centers of the large nodes, sooner or later, occurs followed by secondary infection and suppuration. Frequently lung lesions are also present.

Boeck's sarcoid may simulate Hodgkin's disease. Usually in the former there is an associated uveitis and skin manifestations.

Lymphatic leukemia is differentiated from Hodgkin's disease by a generalized lymphadenopathy blood studies, and bone marrow biopsy The nodes are usually small, discrete, and have no tendency to be matted together in sizeable groups The spleen may be enlarged

TREATMENT

The treatment of Hodgkin's disease as well as the other lymphoblastoma, is unsatisfactory Formerly surgical excision was advocated for a single node or localized mass of nodes. No permanent cures are reported, but frequently worthwhile relief is obtained before there is reappearance of other nodes. Autogenous vaccines have been used by themselves and in conjunction with surgical excision, both before and afterwards, also associated with irradiation, but have proved of no value whatever

Irradiation therapy and, more recently nitrogen mustard have proven to be of the greatest value in controlling the enlarged nodes, along with liver extract and iron, to combat the secondary anemia. For the past thirty years irradiation has to a degree, replaced surgery in the management or the control of enlarged nodes. Two general methods are now in vogue in treating enlarged nodes One method is to treat *all* node areas which include the cervical axillary, mediastinal inguinal retroperitoneal during each series of treatment. The advocates of this plan of therapy hold that irradiation to all node areas even though some areas are not clinically enlarged at the time, would probably prevent or prolong the interval before they become involved. This type of therapy was advocated in 1924 by *Des Jardins*. The other method of irradiating groups of nodes as they appear and the one we follow, is described at the end of this chapter Nitrogen mustard or methylbisamine hydrochloride has been used in treating Hodgkin's disease since 1943 The

details of nitrogen mustard therapy are found at the end of the chapter

PROGNOSIS

Hertzler wisely stated permanent cures of patients with Hodgkin s disease should be viewed with suspicion He reported an occasional case that survived ten and fifteen years. Nathanson and Welch in a review of 184 cases of Hodgkin s disease, report that 25 per cent of the patients were dead in sixteen months 50 per cent in thirty months, and 75 per cent in fifty-seven months At the end of five years after the onset of the disease 57 per cent were dead with no cases living beyond a ten year period

Gilbert among others, has attempted to divide the cases into clinical groups with a prognosis in each In Group I are those which have a slow evolution 20 per cent Group II those presenting an average development 60 per cent Group III develops rapidly the patients surviving only a period of several months and Group IV the disease progresses in spite of all therapy the patient dying within a few weeks " It is a clinical observation that patients having the best prognosis are those who develop nodes first in one superficial area (Group I—slow evolution) and after a period of many months nodes appear in other superficial areas. Cases whose primary site of disease is in the mediastinal and or retroperitoneal nodes, along with constitutional symptoms give a poor prognosis Groups II and III have an intermediate prognosis.

LYMPHOSARCOMA

The lymphosarcoma group are truly malignant lesions arising anywhere in the body where lymph tissue is normally found It may be a localized or diffuse process the latter is the more malignant its course more rapid the former is less malignant and its course more chronic. Stout divides the lymphosarcoma group into as he terms it my unscientific inexact classification according to three histological types reticulum cell, lymphatic cell, and giant follicle lymphosarcoma The lymphosarcomas belong in the group with cells less than twice the diameter of a normal lymphocyte whereas the reticulum cells are those with cells larger than twice the diameter of normal lymphocyte In both of these groups the architecture of the node or mass of lymphoid tissue is obliterated and the space is solidly filled with tumor cells.

The giant follicle lymphosarcoma as the name suggests, is characterized by an enlargement of the lymphoid follicles far greater than that noted in simple hyperplasias. Some variability is present in this group follicles may resemble normal ones except they are enormous in size and are distributed throughout the entire node having an admixture of reticulum cells, and almost normal lymphoid cells. A second variety have giant follicles but contain lymphoblasts and reticuloblasts. The giant follicle type of lymphosarcoma has the best prognosis of all three groups.

PATHOGENESIS

Kundrat first separated lymphosarcoma from a large group of heterogeneous lymphomas Lymphosarcoma has origin in an area of lymph tissue, solitary node, or a group of nodes, simultaneously for example, the chain on one side of the neck and apparently spreads to other groups of nodes by way of the lymphatics. The first symptoms are local rather than general being due to the enlargement produced by the hyperplastic lymphoid tissue wherever located Malignant cachexia is not so apparent as in Hodgkin s disease and the patient may remain in rather good physical condition until late in the course of the disease Fever develops rather late and is of the continuous type There is a moderate leukocytosis with increase in the leukocytes and when the lymphocytes are increased lymphatic leukemia should be suspected As the disease progresses, a secondary anemia develops that is unresponsive to medical therapy

When the primary lesion develops in the neck it begins in a single node or group of nodes, usually in the upper posterior cervical triangle or just beneath the upper part of the

sternomastoid muscle occasionally in the anterior cervical triangle or in the supraclavicular fossa The next most common site of origin after the pharynx and neck, is the mediastinum, from which location it may extend into the supraclavicular fossa

The enlarged node or nodes, are at first discrete but rapidly infiltrate and penetrate the capsule to invade the surrounding structures and skin If a mistaken diagnosis is made the mass is apt to be incised admitting infection and causing a foul, bleeding, ulcerated tumor to persist The lymphosarcoma group violates the dictum of most sarcomas in that they spread only by the lymphatics, new tumors developing in the line of the lymph flow

PATHOLOGY

Cross section of a small solitary node shows a tendency for early invasion of the capsule, in a more advanced stage there is definite invasion. The surface presents a pinkish white or whitish gray color mottled by small punctate hemorrhages. Multiple nodes when involved, are massed together with the surrounding tissue which has been infiltrated with the tumor differing in this respect from Hodgkin s disease

HISTOLOGY

In the lymphosarcoma type, the normal lymphocytic cells are crowded out by the large cells containing a large round or oval hyperchromatic nucleus and a small amount of clear cytoplasm (Fig 550) When the tumor develops in one area of a node, the architecture of the node is soon replaced Numerous mitoses may be observed The cells are uniform in size as compared with Hodgkin's disease which frequently shows a multiplicity of cell form. The stroma is definitely diminished probably being displaced by the infiltrating neoplastic cells. This is in contradistinction to Hodgkin's diseases which shows an increase in the stroma.



Fig. 550

A Lymphosarcoma developing in lymph node, right cheek

B Photomicrograph of biopsy infiltration with large round cells containing large hyperchromatic nuclei with small amount of cytoplasm. Connective tissue stroma definitely diminished (X120)

CLINICAL BEHAVIOR

Lymphosarcoma is distinguished from the other lymphomas by invasive and destruc

tive characteristics and ability to form true metastases in different organs It is progressively fatal One of the characteristics of the lymphosarcoma group is rapid invasion beyond its original confines into surrounding tissues to produce an adherent bulky growth. In the tonsil and pharynx ulceration is early In the lymph nodes, perforation of the capsule with fixation to the adjacent tissues is also early "The pharyngeal and cervical lymphosarcomas are very common and are only second in occurrence to Hodgkin's disease among the serious primary diseases of the neck" (Ewing)



Fig 551

A. Lymphosarcoma developing in lymph nodes, posterior cervical triangle and in parotid gland Nodes are fixed and immobile

B Photomicrograph of cervical lymph node shows large cells with hyperchromatic nuclei Stroma is sparse

Lymphosarcomas have a rather uniform cell type for each of the three groups from which they do not deviate except within the range of cell metaplasia This differs from Hodgkin's disease where there is a variety of cell types at the several stages of the disease

Lymphosarcomas are more frequent in middle or later life as contrasted to Hodgkin's disease that occurs more commonly in young males

Having origin in tonsillar tissue or lymphoid tissue of the nasopharynx lymphosarcomas infiltrate first the local surrounding tissues and then the nares cervical nodes, and may involve the base of skull and cranial cavity In the tonsil or nasopharynx, they grow more rapidly than those in a single neck node or in nodes in other areas of the body perhaps the node capsule temporarily restrains the growth.

The primary lesion in lymphosarcoma is less definite in outline than Hodgkin's disease When it develops in a superficial cervical node or group of nodes, deep in the neck beneath the sternomastoid muscle, it seems to lift the structures above it causing them to bulge forward or may extend from beneath the anterior surface of that muscle (Fig 551) When its origin is the tonsillar pillar or tonsillar fossa, it is detected early if histologi

cal examination of enucleated tonsillar tissue is routinely done In such cases, if not recognized and therapy instituted immediately, an ulcerated lesion develops that fails to heal and rapidly extends to the surrounding structures (Boyd 1942)

Early in the course of the disease a primary discrete lymph node, or group of nodes is elastic in consistency and movable As the process continues, the nodes become immobile both horizontally and vertically and eventually firmly fixed to the surrounding structures, indicative that it is not removable by surgical measures. The tumor gradually infiltrates the surrounding tissues of the neck pharynx trachea esophagus veins and the adventitia of the arteries Obstructive symptoms develop rapidly when the major blood vessels, esophagus and trachea are invaded producing embarrassment of respiration and disturbance of deglutition (Fig 552)

The reticulum cell sarcoma, or reticulum cell lymphosarcoma is supposedly more malignant than the typical lymphosarcoma It occurs more frequently in lymph nodes than in lymphoid tissue of the pharynx nasopharynx, or other areas where lymphoid tissue is encountered (Fig 553 A, B and C)

In suitably prepared and stained material, the cells are large containing a very large kidney-shaped nucleus with abundant acidophilic cytoplasm. The reticulum cells may be observed infiltrating vein walls closing their lumens (Boyd 1942) The stroma is sparse and seems to wind around the individual cells.

Giant follicle lymphosarcoma, or Brill-Symmers disease is characterized histologically by both an increase in the size and the number of lymph follicles The enlargement is due to marked proliferation of lymphoblasts and reticuloblasts The stroma is rather sparse, being crowded out by the proliferating lymphoblasts and reticuloblasts (Fig 554 A and B)

TREATMENT

The treatment of the lymphosarcoma group of lesions, in general is unsatisfactory from the curative standpoint even if the lesion is limited to a single node, or group of nodes, in an accessible area and an early diagnosis is made.

The treatment may be divided into (a) that of a primary lesion which is superficially located and diagnosed early, (b) treatment of the disease after the surrounding tissues are infiltrated or distant metastases have developed causing anemia fever and pressure symptoms from the enlarging tumor masses



Fig. 552 Lymphosarcoma developing in cervical lymph nodes infiltrated surrounding tissues, producing embarrassment of respiration disturbance of deglutition and obstruction of the venous return from the head.

Adequate representative material for histological study is essential for diagnosis and classification. If the lesion is localized to a discrete node, or group of nodes, in the cervical area, thorough surgical excision is recommended by Hertzler (1937) and others. The extensiveness of the radical surgery should be sufficient to completely eradicate the nodes and lymph bearing tissue in the affected side of the neck When the disease is extensive, surgery is limited to the removal of a representative node for histological study Further treatment is by irradiation of involved regions

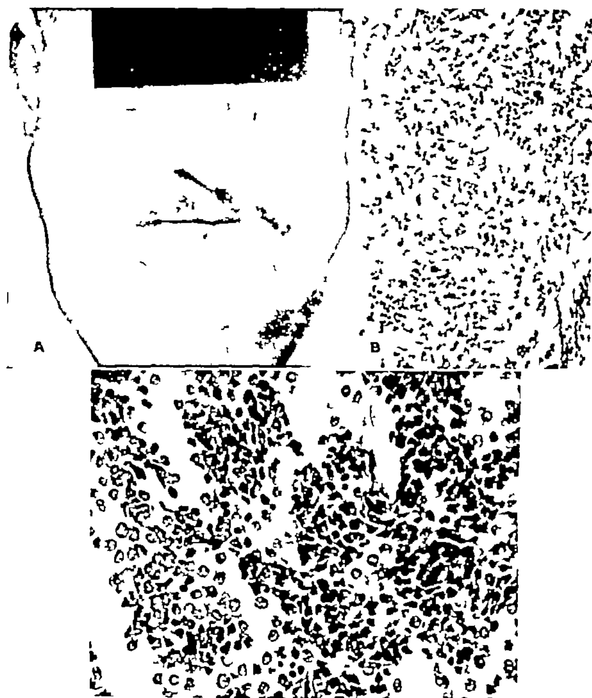


Fig 553

A Reticulum cell sarcoma involving cervical lymph nodes, producing obstructive symptoms of blood vessels, respiration and deglutition

B Photomicrograph of lymph node removed early in course of disease shows evidence of chronic inflammatory reaction Increase in connective tissue stroma.

C. Photomicrograph of lymph node removed from cervical area at a later date shows large cells containing a large hyperchromatic nucleus other cells have rather indistinct nucleus. Stroma is sparse Variability in size of cells.

and supportive measures The type of irradiation and nitrogen mustard therapy administered is outlined in the treatment of malignant lymphomas

PROGNOSIS

The giant follicle lymphoma (Brill Symmers disease) is the most benign of the lymphosarcoma group When only a discrete

node, or chain of nodes, is involved and a diagnosis is made early the lesion and node area completely surgically removed with adequate postoperative irradiation non-recurrences are reported in 65 per cent of the cases When the disease is widespread irradiation therapy is effective in causing a disappearance of the enlarged nodes for periods of months or years.

At times the typical lymphosarcoma, when detected early as a discrete lesion located in an accessible area and completely removed with a zone of lymph-bearing fascia, followed by adequate postoperative irradiation, there may be an extended period of non-recurrence up to five or ten years. Too frequently this ideal picture is not the case as the lesion has developed to such a degree that it has penetrated its capsule and infiltrated the surrounding tissues, as in the pharynx nasopharynx, and cervical area, before a correct diagnosis and proper treatment is instituted. In such cases, irradiation or nitrogen mustard therapy, or a combination of these modalities frequently causes a recession of the mass of nodes for a period of a few days to several months, only to be followed by reappearance of the tumor in local or distant nodes. Again it is emphasized that a patient with lymphosarcoma may be in an apparent state of good health until a short time before death. This differentiates it from Hodgkin's disease in which the patients are chronically ill for a period of months to two or three years before death

Irradiation therapy to a local or multiple areas, or nitrogen mustard therapy alone, or in conjunction with irradiation, causes subsidence of the fever and retardation of the pruritis that so often is an accompanying disturbance

Lymphosarcoma frequently develops in older people, as stressed by Stout from a practical standpoint an extension of life for a few years in individuals sixty or more years of age almost fulfills their life expectancy

Reticulum cell sarcoma probably has the poorest prognosis of the three types. It frequently occurs in the diffuse rather than the local form, and often the primary lesions are in the mediastinum.

In summary as stressed by Stout (1944), the best prognosis is when the lesion is detected early and involves only one node or a localized area of nodes that are adequately surgically eradicated followed by irradiation therapy



Fig 554

A. Giant follicle lymphosarcoma (Brill-Symmers disease) involving cervical lymph node.
B Photomicrograph of cervical lymph node marked proliferation of lymphoblasts and reticuloblasts. Connective tissue stroma sparse.

Lympho-Epithelioma

(*Transitional cell carcinoma*)

A group of tumors termed *lympho-epitheliomas* or *transitional cell carcinomas* develops in the upper anterior area of the neck, just behind the angle of the jaw or under the anterior margin of the sternomastoid muscle or in the pharynx. Lympho-epithelioma is supposed to have origin in the lympho-epithelial elements of the pharynx tonsil base of the tongue soft palate, or pillars of the fauces, and occasionally in the cheek (Fig 555 A, B C and D) They are interesting in that they cannot be strictly classified with epithelial malignancies or lymphosarcoma being neither fish nor fowl they have some of the characteristics of both The term *lympho-epithelioma* was first employed by Regaud Quick and Cutler (1927) introduced the synonym *transitional cell carcinoma* Ewing (1928) in his discussion of these tumors finds it difficult to differentiate between atypical epithelium and hyperplastic endothelium. Hudson (1926) suggests that they are gill cleft carcinomas.

Their clinical behavior and histological picture does not permit them to be placed in any special classification of malignancy In other words, as Hertzler aptly stated they are "outlaws in oncology They are anaplastic, highly malignant and very sensitive to adequate irradiation. Boyd (1942) classifies them as *transitional cell carcinomas* or *lympho-epitheliomas* and states that they account for about 10 per cent of malignant tumors of the mouth and pharynx. In defining *transitional* he refers to it as an intermediate between squamous and simple types of epithelium It is thought that the epithelium covering the lymphoid tissue of the pharynx nasopharynx, base of the tongue and tonsils, is modified by close association with the lymphocytic structure and gives rise to tumors designated as *lympho-epitheliomas* which may be considered a sub-variety of transitional cell carcinomas (Boyd)

Pathology

Even though there is a tendency for the nodes, if several are involved to remain separated from one another and not to become matted together as in Hodgkin s disease, on section, even early the capsule is invaded. The cut surface is grayish white and granular Clinically epitheliomas remain localized longer either in the pharynx or neck, than typical lymphosarcomas.

Histology

Histologically the tumor is composed of sheets or nests of small polyhedral or round cells with large hyperchromatic nuclei The cells vary in size and staining ability Mitoses are frequent. The epithelial or transitional-like cells are surrounded by lymphoid cells. The connective tissue is sparse and seems to wind in strands between the groups of lymphoid cells and the sheets and nests of epithelial cells. *Areas may be seen which suggest keratinization*, leading to the assumption that the tumor might be metastatic from a buccal carcinoma. At times, the architecture and characteristics of the cells resemble amelanotic melanoma (Ewing and Hertzler)

Clinical Behavior

Frequently the first evidence of the disease is a firm, immobile tumor at the angle of the jaw or a tumor in the region of the pharynx, at the base of the tongue the nasal mucous membrane or the tonsillar pillars (Boyd) The tumor does not have the hardness of epithelial malignancy or the mobility that is noted in Hodgkin s disease. The first manifestation of the tumor may be severe pain developing deep in the tissues at the angle of the jaw and radiating to the external ear The pain may be present weeks or months before the appearance of the tumor in the neck or pharynx as noted in two female patients of J W H one a school teacher and the other a dietician Both developed severe pain beneath the angle of the mandible that was referred to

the external ear Repeated careful examinations failed to reveal a tumor of the pharynx

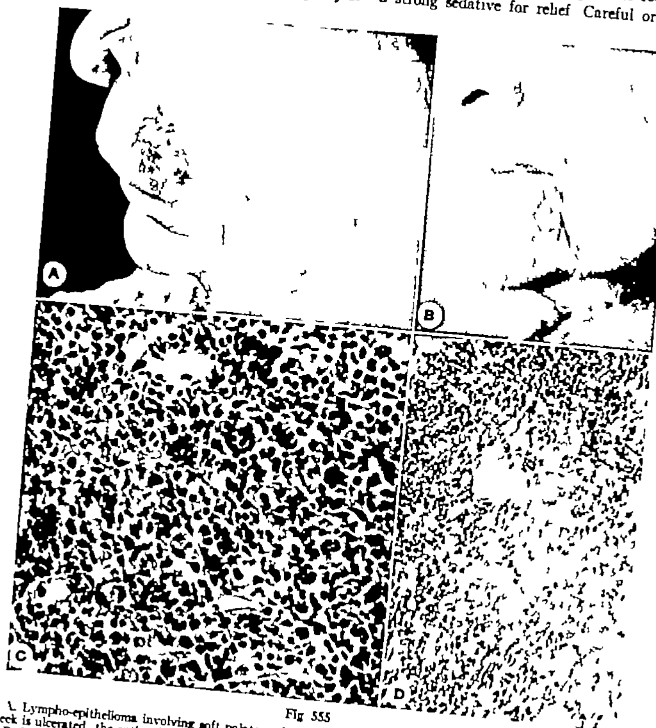


Fig 555

A Lympho-epithelioma involving soft palate and extending to the left cheek. The mucous membrane of the cheek is ulcerated the entire thickness of the lip infiltrated.

B Following adequate irradiation therapy good healing. Later patient developed cervical lymph nodes that were only mildly responsive to irradiation therapy

C Biopsy from tissue of the cheek showed sheets and nests of cells varying in size and shape with hyperchromatic nuclei. Some nuclei are bean-shaped. Moderate round cell infiltration

D Photomicrograph of lymph node from cervical area. Infiltration of cells varying in size and shape with hyperchromatic nuclei Moderate fibrous tissue stroma. Numerous mitoses.

or neck for a period of three or four months, after which a small nodule appeared at the angle of the jaw The pain during the interim became so intense that the patients requ a strong sedative for relief Careful oral amination when the nodules in the neck were detected failed to reveal evidence of a tumor in the nasopharynx. Histological examination

of the neck tumors showed lympho-epithelioma

As the disease progresses adjacent nodes, and still later nodes on the opposite side of the neck become involved As the tumor enlarges either in the neck or pharynx, it invades and becomes fixed to the surrounding structures i e., nerves muscles, and vessel walls The tumor occasionally remains unilateral during its entire course.

When the lesion has its origin in the pharynx or oropharynx frequently it is difficult to detect its presence The earliest evidence may be only puckering or slight erosion of the mucous membrane A primary pharyngeal tumor usually has the histological picture of a transitional cell carcinoma, rather than a typical lympho-epithelioma. Boyd states that these tumors during their course may metastasize to the mediastinal or retroperitoneal nodes

DIAGNOSIS

Lesions having origin in the anterior cervical triangle in the region of the angle of the mandible or under the upper anterior border of the sternomastoid muscle of rapid growth firm consistency immobile both vertically and horizontally and usually associated with severe pain that may radiate to the external auditory canal arouse suspicion of lympho-epitheliomas. Again a lesion on the posterior third of the tongue tonsilar pillar pyriform sinus, or nasopharynx should have adequate biopsy to determine its true nature When a tumor is located in the neck a careful intraoral examination should be made to search for a primary focus

TREATMENT

Lympho-epitheliomas having origin in cervical lymph nodes should have the lesion excised en masse, if possible If frozen section shows lympho-epithelioma and there is no tumor in the pharynx a radical neck dissection should be done at the intial operation followed by x ray therapy (Stout Hertzler and others)

Lympho-epithelioma beginning in the pharynx requires irradiation as the treatment of choice. Both the cervical and pharyngeal lympho-epitheliomas are radiosensitive, sometimes to a dramatic degree although the regression is not permanent. The irradiation therapy should be administered according to the methods enumerated in the latter part of the chapter and is the same as given for Hodgkin s disease and lymphosarcoma. The best prognosis is obtained when the lesion has its origin in a cervical node that is widely excised and followed by radiation therapy Recurrences locally or in the opposite side of the neck are less responsive to radiation therapy The large majority of lympho-epitheliomas eventually prove fatal as they recur locally or metastasize to other areas of the body

LEUKEMIAS

Proliferation and hyperplasia of the lymphoid tissue especially the lymph nodes, associated with toxemia fever loss of weight sweating anorexia, malaise, and arthritic pain are parts of the morbid picture of the leukemias, especially the lymphatic variety The cervical nodes bear the greatest brunt of the hyperplastic change and vary in size from 1 cm. to 3 or 4 cm. in diameter (Fig 556 A B) Frequently a whole chain of nodes will enlarge simultaneously sometimes producing a bulky tumor Ewing has noted by the histological picture found in the lymph nodes that there are two distinct types of leukemias. In the myelogenous type the myelocytes proliferate into the pulp cord distending the cords, increasing their size obliterating the sinuses and producing atrophy of the lymph follicles Large myelocytes and giant nucleated red blood cells are present There is marked hypertrophy and hyperplasia of the node with infiltration of its capsule into the surrounding tissues

In lymphatic leukemia hyperplasia and hypertrophy of the lymph follicle markedly enlarge the nodes, converting the entire node into diffuse lymphoid tissue

Frequently, it is necessary to differentiate the lymphadenopathy of the leukemias, Hodgkin's disease, and the lymphosarcoma group All of these diseases produce certain constitutional symptoms i.e. fever malaise, loss of weight and strength sweating and dermatitis with pruritis The lymphadenopathy is more generalized in the leukemias than Hodgkin's disease or lymphosarcoma



Fig 556

A and B Lymphatic leukemia. Simultaneous enlargement of lymph nodes of both sides of the neck. Nodes are discrete firm mobile.

Blood studies sternal puncture biopsy and histological examination of a suitable lymph node assist in making the correct diagnosis

The leukemias are constitutional diseases their treatment is not considered in this treatise on tumors of the head and neck

TUBERCULOUS LYMPHADENITIS

Tuberculous lymphadenitis was formerly quite common especially in the larger cities, and also where pasteurized milk was not used Tuberculosis of the lymph node is characteristically a disease of childhood. It may occasionally occur in adults or continue from childhood into adulthood Nodes most commonly involved are cervical, bronchial, and mesenteric In children it is thought that the bacilli are of the bovine type transmitted through infected milk The nodes in the digastric triangle are more frequently involved



Fig. 557 Tuberculous lymphadenitis involving the cervical lymph nodes. Lymph node at angle of mandible also in posterior cervical triangle, developed gradually Nodes are tender slightly movable. The nodes in the posterior cervical triangle are matted together forming a large conglomerate mass.

than the other cervical nodes the disease often occurring in individuals who are apparently in good health, the enlargement of either a discrete node or a chain of nodes being slow and insidious (Fig 557) Seldom do tuberculous nodes recede spontaneously, as in infections from other causes.

It is thought that the infection in the cervical nodes has gained entrance through the tonsils. Boyd states the tonsils may be tuberculous or the bacilli may leave no trace of

their passage Septic pockets at the roots of the teeth may also be the sites of entrance

HISTOLOGY

Histological examination early in the course of the disease may reveal no tubercles, but only chronic inflammatory and connective tissue reaction suggestive of Hodgkin s disease before the Reed Sternberg cell stage has developed Later tubercles appear with characteristic giant cells.

CLINICAL BEHAVIOR

The onset of the disease is insidious the first evidence being the appearance of an enlarged node or group of nodes in the submaxillary region at the angle of the jaw or along the jugular chain of nodes. The patient may or may not have an elevated temperature, night sweats, evidence of chronic toxemia listlessness or anorexia The node or nodes are at first firm, discrete and not tender When periadenitis develops, the nodes become matted together and form a conglomerate mass the skin over the mass becoming bluish to reddish in color Later the center is cyanotic and breaks down with discharge of the caseous pus. The mass of nodes may enlarge to 3 or 4 cm. in diameter and at first resemble Hodgkin s disease If rupture of the mass takes place secondary infection ensues, augmenting the patient s symptoms and resulting in a tuberculous sinus which may or may not heal. When spontaneous healing takes place, there is puckering of the skin evidence of prolonged cicatrization

Cross section of an early node shows a pinkish surface similar to that of Hodgkin s disease. As the nodes enlarge the centers undergo caseation and on section appear translucent and of a yellowish granular color Similar cheesy degenerating areas are also found in Hodgkin s disease

TREATMENT

The treatment of tuberculous lymphadenitis includes adequate rest sufficient nutritious diet, sunlight and antibiotics. Streptomycin and its derivatives are of great benefit often obviating irradiation or surgical excision.

In former days the active treatment of tuberculous lymphadenitis was an extensive block dissection of the nodes of the neck such an extensive surgical procedure, perhaps, was seldom justified by the results obtained If the disease is limited to a single discrete node that has not broken down it may be excised surgically with good results.

If caseation has taken place in a conglomerate mass of nodes the local operative procedure should consist of intracapsular removal of the caseous adenoid tissue, followed by irradiation therapy and hygienic measures with antibiotics. Occasionally a single large node is removed *en toto* with its capsule so as not to contaminate the wound Primary healing results

Before the advent of streptomycin therapy x ray irradiation was of great help in reducing chronic small, hard, discrete tuberculous lymph nodes The treatment consisted of small doses (100–200 r) of unfiltered rays, or rays filtered through 1 mm aluminum and ½ mm. Cu (140 Kv) repeated at intervals of one to several weeks and carried on over several months until the nodes disappeared

RADIATION THERAPY OF LYMPHOMAS

By John C Glenn Jr M D

Vigorous treatment of localized lymphomas is capable of producing approximately 50 per cent five year survival Treatment of disseminated or generalized disease is merely palliative, most cases being dead within two years.

For these reasons it seems logical to divide

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the therapy of lymphomas into the two groups mentioned and treat them accordingly

The first group of patients composed of those with a unicentric disease are subjected to intensive therapy Treatment is directed to the primary lesion and the surrounding tumor bed It is important to adequately irradiate this surrounding tumor bed, especially the areas to which lymphatic drainage is expected

Treatment is administered at 250 KV constant potential 15 MA ½ mm copper + 1 mm. aluminum added filtrations H.V L of 1 75 mm Cu 50 cm. target skin distance, and a portal of sufficient size to adequately cover the tumor and its bed Sometimes it is necessary to use more than one portal to properly cover the surrounding area Doses of 200–250 r (measured in air) are administered daily until a tumor dose of at least 2500 r is delivered.

It should be kept in mind that tumors of lymphoid tissues are generally quite radiosensitive and since vigorous treatment first may produce a very appreciable swelling of the mass due to edema we believe a plan of radiophylaxis is safer and more comfortable for the patient Especially is this true in mediastinal tumors or lesions situated near vital structures It is important to deliver the total dose within 3 calendar weeks

In the second group the treatment of a generalized process being intended only for palliation is not nearly so intensive Treatment is directed toward the involved areas using the same factors previously mentioned with the total dose being no more than is necessary to accomplish the desired palliative result This quantity of radiation is usually a total dose of 800 r to 1200 r

Infrequently lesions occur in the skin associated with itching and sometimes herpetic lesions These complications are treated with 120 KV x rays to the local skin lesions and for herpetic lesions the involved nerve root is treated directly with 250 KV x rays Doses of 800 r to 1000 r are usually sufficient to provide symptomatic relief

The advent of nitrogen mustard as a therapeutic agent has been of great import in the treatment of disseminated Hodgkin s disease Indeed it is thought by many that in such cases nitrogen mustard is the treatment of choice Certainly in many instances of generalized disease, nitrogen mustard is much easier for the patient and less difficult to administer from the therapeutic standpoint, than is x ray therapy We have seen patients in whom the disease was refractory to irradiation undergo dramatic improvement following nitrogen mustard therapy Lymphosarcoma shows less satisfactory response to nitrogen mustard therapy than Hodgkin s disease

We firmly believe however that the treatment of localized Hodgkin s disease is still a radiologic problem, unless it should be evident that such treatment is not evoking good response

Radioisotopes have not as yet proven themselves to be worthwhile therapeutic adjuncts. Their use is not without danger which in addition to the technical difficulties of dosage measurement and handling makes them even less desirable as routine therapeutic measures

The treatment of lympho-epitheliomas is often difficult because not infrequently a primary site cannot be located. The patient s presenting symptoms are often earache extraocular nerve paralysis, or headache and since the lesions not uncommonly arise in the nasopharynx, treatment may be directed there

The approach is through two lateral ports measuring 6 x 8 cm with the central ray being directed toward the center of the tumor If the lesion is located somewhat anteriorly it is occasionally helpful to use two additional anterior portals 4 or 5 cm in diameter through the maxillary areas. Care should be taken to protect the eyes and teeth when these portals are used Sometimes we have used additionally an intraoral cone when the location of the lesion permitted.

Treatment factors are 250 KV, 15 MA 2 mm Cu + 1 mm Al 50 cm. T.S D 6 x 8 cm port and doses of 200 r or 250 r daily to a total of 2500 r to 3000 r per port.

Metastatic nodes in the neck are treated using the following factors 250 KV 15 MA ½ mm. Cu + 1 mm Al 50 cm. T.S.D with doses of 250 r to a total of 3000 r One portal of proper size to cover the metastatic area is generally sufficient

Should the roentgen therapy be preceded by radical surgery it is necessary to reduce the total dose somewhat since the fibrosis following surgery reduces the ability of otherwise normal tissues to recover Also healing of the operative wound itself may be interfered with if rigorous treatment quickly follows radical surgery

NITROGEN MUSTARD THERAPY OF LYMPHOMAS

Patients that become resistant to irradiation therapy may respond quite favorably to nitrogen mustard therapy

The standard dose of nitrogen mustard is $\frac{1}{10}$ mgm. per kilo of body weight injected daily or every second day until three to six doses are administered the daily dose never exceeding 8 mgm This plan of therapy is considered to be sufficient to induce remissions in most cases Patients who are very ill should have smaller initial doses. Nitrogen mustard is furnished as the dry white crystalline hydrochloride salt of mustard in small sterile bottles, containing 10 mgm. of the drug The drug is dissolved in 10 cc of sterile physiological saline The salt goes into the solution promptly and the calculated dose is withdrawn into a sterile syringe Injection is made immediately into a suitable vein Care is taken to avoid touching the skin or the mucous membrane of the patient or the physician with the solution It is necessary and important that the drug be injected promptly after it has been dissolved, as its activity is quickly dissipated If the concentrated drug is injected too rapidly phlebothrombosis may result or if there is extravasation into surrounding tissue necrosis and sloughing may ensue

A striking clinical remission may be obtained within four or five days in patients with fever and localized or generalized lymph node enlargement Patients with involvement of the mediastinal and retroperitoneal nodes receive general clinical remission i.e. increased feeling of well being improvement of appetite gain in weight subsidence of dermatitis and pruritis. The duration of the remissions varies from a few days to several months. The lymph nodes decrease in proportion to their size the large nodes decrease moderately in size, and the smaller nodes return to normal limits. Patients with an enlarged spleen frequently have a marked reduction in its size following nitrogen mustard therapy

Both lymphoid tissue and actively proliferating cells are vulnerable to the cytotoxic action of the mustard In patients with lymphomas, the toxic effect of the mustards is on the hemopoietic tissues and is an extension of the therapeutic effects The mustards have a selective action on primitive cells and abnormal hemopoiesis, and affect all elements of bone marrow producing a moderate normochromic anemia thrombocytopenia, leukopenia and granulocytopenia Nitrogen mustard causes death of cells in an unexplained manner The blood-forming organs are more susceptible to its action than any of the other systems The response observed in the peripheral blood is in direct relationship to the dose administered. The blood picture of patients treated with this drug must be observed carefully and repeatedly

Nitrogen mustard and radiation therapy have the same general effect on hyperplasia of the reticuloendothelial cells, lymphoid cells, and bone marrow Whether one of these therapeutic modalities has an advantage over the other cannot be determined at this time Both produce salutary effects and remissions The mustards are frequently used in patients who have become resistant to radiation therapy In some of these patients who are unresponsive to radiation or to mustard alone there has been favorable response when both agents are used simultaneously Systemic reactions are

about the same with both agents. The margin of safety is narrower with nitrogen therapy than with radiation. Newer forms of mustards may be developed that will give a wider range of treatment and be more potent in action and less toxic. Nitrogen mustard therapy is less expensive to the patient as no costly equipment is required as with radiation therapy Nitrogen mustard is supplied through the Committee on Growth of the National Research Council, and obtained from Merck and Company

Striking beneficial results of a temporary nature are obtained with mustard therapy in some patients who are extremely ill, and in others who have become resistant to irradiation therapy On the other hand as noted by most observers 20–25 per cent of the patients in the chronic group obtain poor results and in another 10–20 per cent the results are only fair (Rhoads 1946) It is difficult to estimate in advance which cases will respond favorably It is doubtful whether this form of therapy used singly or in conjunction with radiation extends the length of life of the average patient with Hodgkin s disease but it definitely makes the majority more comfortable

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mastoid muscle on the left side and in close proximity to the thoracic duct is the frequent site of metastasis from tumors in organs drained by the thoracic duct most commonly tumors of the gastrointestinal tract lungs, and mediastinum Occasionally a similarly involved node is found on the right side. Embryonic tumors of the testicle often metastasize to Virchow's node. Malignant tumors of the breast occasionally remain unnoticed by the patient particularly if the breast is large until a supraclavicular node enlarges. On one occasion such a metastasis occurred a third of the way up the neck and was the first symptom which took the patient to a physician Even the physician missed the primary tumor in the breast until it was looked for by the surgeon It must not be forgotten that tumors below the clavicle may metastasize into the upper neck. One of our cases came because of a painless tumor at the level of the hyoid bone Careful examination revealed no primary focus in the head and neck. Unfortunately an x ray of the chest was not made at that time At operation the mass was found to be firmly adherent to the carotid sheath but was removed with its capsule. Pathological diagnosis was branchial cleft carcinoma based on the intermingling of squamous carcinoma with hypertrophied lymph tissue Postoperative radiation was given Over a year later the patient consulted another surgeon with a similar lump on the opposite side of the neck at the same high level Pathological diagnosis then was metastatic carcinoma. Several months after the second operation the patient developed a cough and on x ray examination a primary cancer of the lung was found This case illustrates quite forcefully the importance of x ray examination of the chest in every case of neck tumor When the primary focus is found in the head or neck (larynx or hypopharynx) a chest film is also necessary to rule out metastases to the lungs or mediastinum.

Although the location of the primary lesion governs to a greater or lesser degree the site of metastases, bizarre lymphatic spread is common Every now and then cross-metastases are seen that is the primary lesion occurs on one side of the body and the metastases on the other Cancer in the anterior part of the mouth usually metastasizes to the submental or submaxillary nodes, but it is not uncommon for the first metastases to appear in the superior deep cervical node or lower jugular chain of nodes.

The histological type of the primary tumor influences the extent and rapidity of growth and the multiplicity of metastases. Slowly growing well differentiated squamous cell carcinomas usually metastasize to one or two nodes at first and grow slowly for a period Embryonic infiltrating carcinomas which penetrate the muscle and lymphatic channels early may spread almost simultaneously to many nodes in the neck. In these cases nodes are usually small discrete and hard at first and later as the disease progresses, increase and become matted together forming large fixed masses.

Since most tumors that metastasize into the neck occur in the head (oral cavity pharynx larynx accessory sinuses, etc.) where bacteria abound infection often metastasizes along with the tumor Therefore it is not uncommon that the early metastatic nodes appear as inflammatory nodes and are softish and slightly tender This confusing picture should not lead the clinician to overlook the possibility that deep within the node cancer is also present On the other hand it is possible that the metastasis of the tumor causes hyperplasia of the lymph node as a defense mechanism. In either case it is not uncommon for the node to recede and even become impalpable for a time after the original enlargement especially when the primary lesion is treated and heals. Because of these difficulties in accurate diagnosis all palpably enlarged firm nodes in the neck associated with a primary malignant neoplasm should be considered metastatic until proved otherwise

It has been estimated that 50 per cent of normal individuals have palpable lymph nodes in the neck These lymph nodes are usually

small, discrete firm, and freely movable and when located in the path of possible metastases from malignant disease should be watched carefully for any change in size and consistency suggestive of malignant invasion Experience is the best guide in differentiating between normal and pathological nodes.

Metastatic Tumor without Evidence of Primary Tumor

Many times the clinician is consulted for a tumor in the neck, so located and with physical signs to make the diagnosis of metastatic tumor fairly certain In fact, biopsy proves the existence of metastatic malignancy but all clinical and laboratory investigation fails to show the primary site. The biopsy may suggest tumor of the gastrointestinal tract lung mediastinum, or squamous cell cancer possibly arising somewhere in the accessory sinuses, pharynx, or larynx etc. In these cases time usually permits the primary tumor to grow sufficiently large to produce symptoms or to become recognizable by various methods of diagnosis Metastatic lymph nodes located opposite the larynx may receive cells from a small tumor in the pyriform sinus which is very difficult to observe Tumors in the vault of the nasopharynx or sphenoid sinus are often silent for months or a year or more even though metastatic nodes in the neck suggest the presence of a primary tumor in these locations One of our cases a man in his late thirties was referred by Thomas O Rourke otolaryngologist because of a swelling on the right side of the pharyngeal wall This swelling was biopsied under general anesthesia The biopsy wound bled so profusely that adequate tissue was not obtained Pathological diagnosis was chronic inflammatory disease Later a metastatic lymph node on the opposite side of the neck which was biopsied showed only chronic inflammation. From the clinical picture it was obvious that the patient had a primary malignancy somewhere with metastases to the neck Several months later the complication of double vision occurred which was thought to be due to primary tumor or to metastases in the region of the sixth cranial nerve All local examinations were negative and x ray films of the base of the skull and the sinuses were inconclusive Finally a year or more after the primary swelling appeared in the pharynx a small tumor that was observed in the nasopharynx was biopsied and proved to be squamous cell carcinoma This case illustrates the fact that it is necessary to continue the search for the primary tumor when biopsy of the lymph node in the neck shows metastatic tumor or even when the clinical picture is suggestive of tumor (see Chapt. XVII)

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of any tumor of the neck must be between inflammatory lesions, primary neck tumors and metastatic neck tumors

Inflammation

Acute inflammations are, as a rule not difficult to diagnose as there are the usual signs of acute infection. The patient may give a history of having had a recent sore throat cold, or infected tooth, which may or may not have been extracted. The adjacent lymph nodes, when involved are tender swollen softer than malignant nodes, and usually freely movable The patient may or may not have an elevation of temperature The skin over the node may show redness edema and even attachment to the node if the inflammatory process has penetrated the lymph node capsule and involved the surrounding connective tissue and muscle causing fixation of the node In such cases, suppuration is impending Inflammations rarely involve the midline and usually occur in the site of lymph nodes Abscesses follow the fascial planes and produce brawny masses They usually offer little difficulty in differentiating from tumors because of the characteristics of acute or chronic inflammation Inflammatory nodes may be single or multiple

Lymph nodes involved by chronic inflammatory reactions offer greater difficulty in differential diagnosis between lymphomas on the

one hand and multiple metastases from a malignant tumor on the other Usually chronic inflammatory nodes are discrete, freely movable, and have been present a long time without much change. Although the classical picture of tuberculous lymphadenitis is described as being one of a group of nodes matted together we have seen many cases of chronic tubercular lymphadenitis in which the nodes are firm, freely movable, and discrete

PRIMARY TUMOR

The characteristics of primary tumor of the neck are adequately described in Chapters XVII and XVIII We might reiterate some of the essential points for the sake of clarity The only primary tumors that occur in the midline are the thyroglossal tract lesions and occasionally a thyroid adenoma Primary neck tumors are usually along the lateral side of the neck. They occur in the epicytes of embryonic rests normal organs and lymph nodes (lymphomas) Characteristic to all the embryonic primary tumors may be cystic rubbery or hard. The lymphomas are usually discrete in the early stages and matted together later We cannot agree that there is a great difference in the characteristics of lymph nodes in the early stages of lymphosarcoma and Hodgkins disease. The latter is reportedly usually a matted together group of nodes This is true in the later stage but now that many patients are coming earlier and have prompt biopsies it is found that lymph nodes involved by Hodgkin s disease frequently are discrete and freely movable particularly if the nodes are only a few in number An important point in differential diagnosis of lymphomas from metastatic disease is the presence of lymph nodes in other areas of the body namely the axilla groins etc. Early primary tumors do not involve the skin unless there is a sinus tract or cyst that has become infected and attached to the skin In the later stages, primary tumors may infiltrate the skin Usually the embryonic rest type of primary tumor is single Lymphomas may or may not be multiple.

METASTATIC TUMORS

Metastatic tumors occur rarely in the submental midline from cancer in or near the midline of the tongue, floor of the mouth, or lip, one notable case confirmed by microscopic examination, metastasized from the nasal septum (Chapter XIII) Usually however metastatic tumors are located in the lateral regions of the neck and may be multiple or single. Commonly they appear as single metastasis, particularly if the growth is well differentiated and slowly progress to other nodes In patients afflicted with more rapid anaplastic neoplasms, several nodes may become involved almost simultaneously Metastatic tumors of the neck occur at the site where lymph nodes are normally present Later, enlarged nodes become diffusely attached to the surrounding tissue and coalesce, forming large masses which later break down and ulcerate The suppuration of these nodes is due either to the presence of metastatic infection from the oral cavity or pharynx or to eschemic necrosis from the loss of blood supply to the central portions of the tumor because of the tremendous size attained.

The characteristics of metastatic tumors vary with stages of the disease. Early they are usually discrete and movable later as the capsule becomes perforated the involved lymph nodes become fixed to the surrounding tissue As noted above, these metastatic tumors may begin as swollen tender nodes, which may regress for a time, giving the impression that perhaps they are inflammatory in character, a pitfall into which many have fallen with the result that the metastasis gets the upper hand before it is really recognized. Later these nodes reappear hard, non tender and fixed. Treatment of them should have been begun when they were first noted

BIOPSY

The final diagnosis is always made by histological examination of tissue removed.

Surgical biopsy is preferable and readily done under local anesthesia when an adequate

amount of tissue is obtained for careful histopathological examination. The theoretical danger suggested by some writers is markedly outweighed by the value of accurate diagnosis which will direct the proper treatment.

Under local anesthesia of 1 per cent procaine or novocain, the skin is opened under sterile conditions and the node localized If the node is not too large, it is removed in its entirety If it is large and fixed then an adequate piece is excised and the capsule of the node closed. The wound is closed without draining

Aspiration biopsy The technic of aspiration biopsy was perfected at the Memorial Hospital in New York (Martin and Ellis, 1934) (see Chapt I) Aspiration biopsy has been partially successful in our hands There are a number of cases from whom we have obtained sufficient tissue for accurate pathological diagnosis. Our successful attempts have been in aspirating large tumor masses composed chiefly of epithelial tissue which is soft enough to be cut by the serrated end of the aspiration needle and to remain within the needle while it is withdrawn Dense fibrous tumors have not yielded so well to aspiration biopsy

Proper and adequate therapy cannot be administered to tumors of the neck without accurate histological diagnosis For this reason, biopsy is an essential procedure in working out the diagnosis of any neck tumor

TREATMENT

When the diagnosis of metastatic carcinoma of the neck has been made the choice of treatment whether radiation therapy or surgery will depend upon many factors. The improvement of technics of radiation therapy and surgery have been followed by better end results but there still remains much to be desired by way of increasing the number of permanent cures and adding to the comfort and well being of patients from whom the disease cannot be eradicated completely

Factors Influencing Choice of Treatment

SITE OF PRIMARY NEOPLASM

The vast majority of primary sites from which metastases occur in the neck lie in the head or throat. Many of these primary neoplasms are curable, so that if the metastases are in the early stages attempts should be made to eradicate the disease completely The choice of treatment will vary with the site of the tumor In several preceding chapters, discussions are given relating to the management of metastases from cancers of the lips, floor of the mouth and tongue, buccal cavity, pharynx and tonsils, etc which will not be repeated here

When the primary lesion is located below the clavicle, treatment of the cervical metastases will be palliative only The treatment, usually radiation therapy, should be planned in such a way as to give the maximum amount of shrinkage of the tumor and therefore relief to the patient with a minimum amount of discomfort by way of skin reactions and subsequent slough of the tumor itself Our usual plan is to give 2000 r of x-ray through a proper sized cone, using the following factors 200 Kv 15 ma 0.5 mm. Cu 1 mm. Al filtration. When the tumor is large the dosage may be repeated through two portals crossfiring upon the mass. Small metastatic nodes sometimes are best implanted with radon seeds By implanting the seeds perpendicular to the skin very little skin reaction is obtained eliminating the danger of slough The aim of radiation therapy x ray and radon alone or combined is to deliver from 6000–8000 roentgens or gamma roentgens, depending upon the modality used within the tumor itself, with as little injury to the skin as possible

HISTOLOGICAL TYPE OF PRIMARY LESION

The anaplastic tumors grow rapidly and metastasize in a more widespread fashion so that the choice of treatment will depend to a large extent on the size and number of metastases Often a combination of irradiation therapy followed by surgical removal is indicated

More highly differentiated tumors are slow growing and slow to metastasize They are not very radiosensitive In this group surgical removal is preferable reserving radiation for use in the event of a recurrence The radiation is concentrated at the smaller sites of recurrence rather than attempting to spray the entire neck in one area

STAGE OF PRIMARY GROWTH

The stage of the primary growth is an important consideration in selecting treatment for metastases When the primary tumor is eradicated and the metastasis is of small or moderate size vigorous attempts are made to cure either by radiation or surgery (see following paragraphs)

When the primary tumor is thought to be curable therapeutic attempts are directed, often simultaneously at the primary growth and the metastases (See section on composite operation in this chapter)

Patients having metastases in the cervical region and an advanced primary growth are usually treated for palliation only In such patients, the treatment of the metastatic disease is usually a radiological problem. Nodes up to 2 or 3 cm in diameter are treated through small x ray cones to the point of skin tolerance, followed by implantation of radon seeds Not uncommonly such palliative treatment makes the patient comfortable for months or years. When the metastases are more advanced associated with large multiple nodes or a large fixed mass x ray therapy should be given through one or more portals, depending upon the case at hand and if the metastases prove to be radiosensitive and reduces under such x ray therapy radon seeds or radium element needles are implanted If the metastasis proves to be resistant to radiation therapy it is inadvisable to push the implantation as the discomfort to the patient outweighs the value of the therapy

STAGE OF NODE INVOLVEMENT

For the sake of guidance in making a choice of therapy we would divide the cervical metastases into four groups

1 The greatest discussion *relating to the* choice of treatment of metastatic malignancy revolves around those cases in which lymph nodes are not palpable Many clinicians feel that the hazards of surgical removal outweigh the value obtained in radical or semi-radical neck dissection when the nodes are not palpable Our feeling is that the choice of neck dissection when lymph nodes are not palpable varies with the primary site of the tumor and its histological structure Again reference is made to chapters dealing with the various types of primary lesions for the criteria of neck dissection when the nodes are not palpable For example, cancers of the lips which are histologically well differentiated namely type I and when the tumor is less than 3 cm in diameter suprahyoid neck dissections are not done when nodes are not thought to be involved Metastasis is slow and it is wise to wait until the nodes are palpable before resecting them On the other hand when the primary lip lesion is of a histological grade III or IV metastases are more rapid and a routine suprahyoid neck dissection, even though the nodes are not palpable is advisable Also we hold that radical neck dissection should be done when the primary lesion is in the tongue or floor of the mouth even though the lymph nodes are not palpable

There are no criteria known to guide the clinician in determining the presence or absence of microscopic metastases in lymph nodes when the nodes are not palpable Indeed it is not uncommon to find that palpable nodes in the drainage area from the mouth show only hyperplasia when examined microscopically even though active cancer is present in the oral cavity Statistics showing the presence of microscopic cancer in non palpable nodes vary Martin (1941) stated that in forty patients presenting themselves with cancer of the tongue and without palpable cervical metastases 12 per cent developed cervical metastases later Also in twelve patients with cancer of the cheek and without palpable cervical metastases 17 per cent later had cervical metastases. On the other hand Phillips (1931) speaks of lymphatic dissemination on this wise The

uncertainty of clinical examination of the cervical lymph glands has prevented the finding of any correlation between the histological classification and the tendency to lymphatic dissemination For of 59 cases with lymphatic metastases clinically 22 (37.3%) were proved innocent microscopically and of 31 cases with no clinical metastases 16 (51 6%) contained carcinoma deposits microscopically Lane-Claypon similarly found nodal metastases in over half of the cases of carcinoma mammae in which the axillary nodes were clinically not involved."

Modern surgical technics and supportive measures, as outlined in Chapter I, have reduced mortality to a very small percentage This small mortality is outweighed by the value of removing lymph nodes before they have become palpable

2 Small firm, movable, palpable lymph nodes are a definite indication for neck dissection

3 Medium-sized lymph nodes which are fixed should receive preoperative irradiation before surgical removal. Such radiation may be carried out by x-ray or radon implantation which often makes operation safer by surrounding the nodes with a dense area of fibrosis and also devitalizing the growth itself Should the clinician decide upon a composite operation, that is, removal of the primary growth and lymph nodes en bloc at one operation care must be exercised not to damage the skin by the radiation which will often delay healing or even cause fistulae At times, it is preferable to limit the preoperative radiation to implantation of radon seeds so as to reduce the damage to the skin When it is contemplated to precede the composite operation by some form of plastic operation to prepare for closure of the mouth wound and the formation of a floor of the mouth (see section on composite operation), x ray therapy may be given through the skin in amounts below that which will cause sclerosis and obliterating endarteritis of the degree which will interfere with healing Experience and judgment are required in evaluating these fine points of therapy It is then that oncology becomes an art rather than a true science

4 As a rule, extensive and fixed metastatic nodes are treated palliatively only In the occasional case where the metastasis is limited to the suprahyoid region and even though the metastatic mass may be fixed to the underlying tissues, skin or jaw, heavy preoperative irradiation will so devitalize the growth and surround it by dense scar tissue that electro-surgical removal in four to six weeks is accomplished successfully Under such circumstances, it is usually necessary to plan on a secondary plastic repair

CONDITION OF THE PATIENT

The physical condition of the patient is an important factor in determining the type of treatment Many patients with cancer about the oral cavity and face are old or debilitated from inadequate nutrition, infection starvation, and long standing pain Suitable supportive measures including forced feeding by intranasal or oral tube or parenterally will build up the physical reserve and so the patient will be able to withstand long surgical procedures. At other times carefully planned and executed irradiation therapy will be of palliative value. Advanced age alone is not a contraindication to radical neck dissection

Surgical Treatment of Cervical Metastases

TREATMENT OF CERVICAL METASTASES FROM PRIMARY CANCER OF THE SKIN AND SALIVARY GLAND

It has been our practice not to perform a radical neck dissection on patients with squamous cell carcinoma of the skin of the face and neck unless the nodes are palpable, since metastasis from these primary tumors is rather slow Should lymph nodes be palpable, radical block resection is indicated. Operation in continuity is hardly a surgical possibility in many cases. Primary squamous cell carcinoma on the eyelids, for instance, metastasizes first to the preauricular nodes and then on down into the cervical chain, requiring a rather dis-

figuring and extensive procedure Squamous cell carcinoma on other areas of the face which have lymph node metastases can be resected in continuity if metastases are palpable

Resection in continuity of melanoma and associated lymph nodes should be done imme

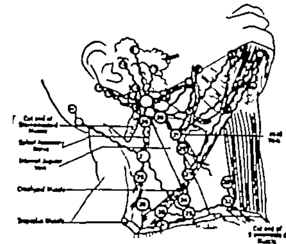


Fig 558. Principal Lymph Node Groups of the Head and Neck

1–4	Submental Nodes
5–9	Submaxillary Nodes
6 7	Mid-mandibular Nodes
10–13	Preauricular Nodes
14 15	Mastoid Nodes
16 17	Occipital Nodes
18	External Jugular Nodes
19–25	Internal Jugular Nodes
19	Subparotid Node
20	Subdigastric Node
21 22	Bifurcation Node
23	Omohyoid Node
24 25 29 30 31	Supraclavicular Nodes
26–29	Deep lateral Chain
29 30	Transverse Cervical Chain
31	Subclavian Chain
32 33	Anterior Deep Nodes

(Courtesy Taylor and Nathanson. Lymph Node Metastases" Oxford Univ Press, 1942.)

diately upon the diagnosis of melanosarcoma (see Chapt IV)

Carcinoma of the salivary glands requires block resection of the lymph nodes of the neck in continuity with the primary growth (see Chapt XI)

SURGICAL TREATMENT OF CERVICAL METASTASES FROM PRIMARY CANCER IN THE ORAL CAVITY

The surgical treatment of metastatic tumors in the neck is divided into three operative procedures (1) suprahyoid neck dissection (unilateral or bilateral) (2) radical neck dissection and (3) composite neck dissection with removal of the primary growth in continuity Figure 558 illustrates the principal lymph node groups of the head and neck and their areas of drainage. A prerequisite of any operation on the neck is a thorough knowledge of the location of the lymph nodes and their drainage sites. Nodes draining the lip are located in the submental and submaxillary region. Lymphatics from the upper lip drain occasionally into the preauricular nodes and also into the submaxillary nodes (Chapt VI) All of these groups eventually drain down along the carotid sheath. Retrolymphatic drainage and cross metastases occasionally result in the appearance of a lymph node filled with metastatic disease in bizarre locations. For this reason, the neck dissection, whether it be limited to the suprahyoid region or whether it takes in the entire side of the neck must be planned and executed in such a way as to remove all possible nodes which might harbor metastatic disease.

Suprahyoid neck dissection is carried out usually for carcinoma of the lip A detailed description of the operation is given and illustrated in Chapter VI Suprahyoid neck dissection has no place in the treatment of metastases from cancer of the tongue or floor of the mouth buccal mucous membrane or gingiva Tumors originating in these sites are much more malignant than those on the lips and metastasize more extensively Emphasis is laid on the fact that important lymph nodes lie on the mandible along the external maxillary artery and vein These nodes should be taken in any suprahyoid neck dissection and also in any radical neck dissection particularly if the primary site is in the upper lip lower lip or buccal mucous membrane or gingiva. Metastases to these nodes from cancer of the tongue and floor of the mouth are not common In removing these nodes one can dissect out the lower branch of the facial nerve which goes to the lower lip and thereby prevent annoying paralysis to one side of the lower lip

Radical neck dissection now has a much

Retropharyngeal glands

Afferent vessels of retropharyngeal glands

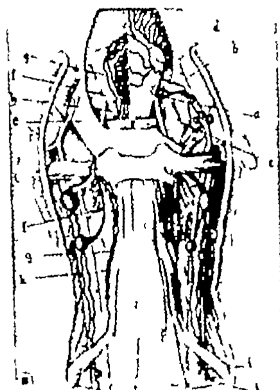
Afferent vessel to deep cervical glands

Glandular nodule

Gland of deep cervical chain

Efferent vessels of retropharyngeal glands

A



B

Fig 559

A Lymphatics of pharynx (Poirier and Charpy)

B Lymphatics draining tongue (from Kuttner) Note that in the upper neck, the posterior belly of the digastric muscle lies lateral to the large vessels and in the lower neck, the omohyoid muscle also lies lateral to the vessels. These anatomical relations are helpful in dissecting away adherent masses from the large vessels. If the operator stays lateral to these muscles, there is little likelihood of injuring the large vessel.

greater place in the treatment of metastatic cervical cancer than any time in the past twenty five years. Although the advent of radiation therapy in the treatment of cervical metastases for several years reduced the number of cases submitted to radical neck dissection some clinicians never lost sight of the value of the operation It is gratifying to watch the pendulum swing back toward radical neck dissection in the last decade We favor routine radical neck dissection in all cases of cancer of the



Fig. 560 White man with carcinoma of the floor of the mouth and metastases to the lymph nodes in the parotid gland region. Before admission he had been advised to have an operation for a parotid tumor The primary lesion in the floor of the mouth had been overlooked. This patient obviously is not suitable for surgery but should be treated with irradiation.

tongue and floor of the mouth and gingiva whether or not lymph nodes are palpable This view is more radical than many authorities hold but since a high percentage of patients suffering with carcinoma of the tongue and floor of the mouth who on admission do not have palpable nodes develop them sooner or later in the course of the disease it seems justifiable to accept this radical view With modern advances in surgery the operative mortality is at a low point Herbert Willy Meyer (1949) holds a still more radical view on this point He feels that in carcinoma of the tongue dissection of the cervical lymphatics on both sides of the neck from the mandible to the clavicle should always be performed This is done in two stages. Our statistics show that the results are better depending on the extent of the lymph node dissection Meyer's statistics are "bilateral complete dissection 5-year arrest 50 per cent bilateral to omohyoid crossings, 5-year arrest 30.5 per cent unilateral to omohyoid crossings, 5-year arrest 14.8 per cent"



Fig 561 White man with carcinoma of the floor of the mouth and metastases to the submaxillary lymph nodes. He had previously been diagnosed as submaxillary gland tumor the primary lesion in the mouth being overlooked. This type of case is not suitable for operation but radiation therapy should be used

In patients with cancer of the lip who on admission did not have plapable lymph nodes, Kennedy (1934) found 14 per cent to have metastases, and when the lymph nodes were palpable 33 per cent had metastases. Morrow (1937) found that when lymph nodes were not palpable in cancer of the tongue, they had metastases in 39 per cent and when they were palpable there were metastases in 52 per cent Regaud (1932) found 60 per cent of lymph node

metastases from cancer of the tongue when the nodes were palpable Simmons (1931) found that in oral cancer without palpable lymph nodes, 34 per cent had metastases, and with palpable lymph nodes, 55 per cent had metastases. Phillips (1931) found that in buccal carcinoma lymph nodes that were not palpable showed on resection 51 per cent involvement



Fig 562. White man, aged 58, with carcinoma of the base of the tongue and metastases to the submaxillary and carotid chain of lymph nodes. His main complaint was tumor on the right side of the neck. He had had no symptoms relative to the cauliflower growth that involved the lateral pharyngeal wall and extended across the midline of the base of the tongue. There were two nodes on admission one at the angle of the jaw and one at the level of the cricoid cartilage.

and when the lymph nodes were palpable in cases with buccal carcinoma 63 per cent showed metastases. These figures all point to the importance of early radical neck dissection In Herbert Willy Meyer's Clinic, the operative mortality for suprahyoid node dissection is 1 2 per cent, and the operative mortality for block dissection to the omohyoid crossing is 4 2 per cent

As we now practice radical block dissection of the neck the following groups of nodes are removed submental submaxillary omohyoid, lower pole of the parotid nodes, carotid nodes, posterior digastric deep cervical nodes, posterior deep cervical nodes all along the internal jugular vein, including those posterior to it, and supraclavicular nodes. In other words our routine neck dissection includes all the lymphatic-bearing fascia from the border of the trapezius muscle posteriorly to the midline in front, and from the clavicle below to the mandible above and as far posteriorly and cephalad as the lower pole of the parotid gland and the nodes behind the posterior belly of the digastric and stylohyoid muscles. These latter



Fig 563 Colored man aged 50 came in complaining of a lump in the right side of the neck. Primary lesion was proved to be a carcinoma at the base of the tongue which had given no symptoms. He improved markedly under radiation therapy and at no time complained much of the primary lesion.

muscles are either lifted forward, the nodes dissected out and the muscles sutured back into place or the muscles are taken in the block with the specimen depending upon the local situation. It is to be remembered that cancer of the mouth and pharynx is a serious malady at best and all possible lymph node involvement should be eliminated

Technic for radical dissection of the lymph nodes of the neck. To give the history of radical neck dissection would require a long discussion, dating back to Kocher who, in 1880, introduced a method of opening the mouth from behind and below the angle of the jaw to reach the base of the tongue and remove it with the

lymphatic gland situated there" (See Chapt IX on carcinoma of the tongue and floor of the mouth) In recent years several technics of neck dissection have been reported by Semken (1932) Fischel (1935) and Brown and McDowell (1944) Brown and McDowell, and others removed the platysma muscle with the specimen We have not followed this plan routinely but in selected cases where the primary growth was in the skin parotid gland buccal mucous membrane or gingiva or where the metastases had evidently involved the superficial cervical fascia and platysma muscle, the latter was removed with the specimen The type of skin incision varies with the choice of the operator The Kocher incision, shown in Figure 564 A is quite satisfactory Occasionally it is an advantage to convert the Y incision into an H by a third incision through the skin of the neck just above the clavicle Theoretically this gives wider exposure in the supraclavicular region but practically we find that this area can be dissected out cleanly through the usual Kocher incision Skin flaps are dissected back on all sides, so as to expose the neck from the clavicle below to the mandible above and from the midline in front to the trapezius muscle and mastoid process posteriorly Since the dissection is similar to the early stages of our composite operation which is described later on in this chapter illustrations are not repeated here Also since the radical neck dissection is given in detail in the description of the composite operation it would be repetitious to re-describe it in this section The neck dissection is carried out from the clavicle up to the jaw as in the composite operation and as far posteriorly and superiorly as the tail of the parotid and the tip of the mastoid The submaxillary triangle is cleaned out up to the mylohyoid muscle As illustrated and described in the discussion of the composite operation the neck dissection may be carried from front to back or back to front depending upon the choice of the operator The more we do the back to front operation as shown in Figure 568 the more we prefer it

The object of the operation is to remove in one block the lymphatic-bearing fascia of the neck including the superficial fascia and the investing layer of the deep cervical fascia underlying the posterior border of the sternocleidomastoid muscle and that portion of the fascia around the jugular vein, slipping it free from the carotid artery By following along the fascial plane a clean block of soft tissue, covered superficially by the platysma muscle or superficial cervical fascia, or both, as the case may call for and posteriorly by the investing layer of the deep cervical fascia is removed This block of tissue contains the sternomastoid muscle, the internal jugular vein the omohyoid muscle, the posterior belly of the digastric muscle, the stylohyoid muscle, the submental nodes, submaxillary nodes, and submaxillary salivary gland and the deep cervical nodes and the digastric nodes high in the posterior triangle of the neck The sternomastoid muscle is cut at its attachment to the mastoid process and the posterior belly of the digastric is severed from the digastric groove of the mastoid The stylohyoid muscle is separated from the styloid process These two latter muscles and the styloid process are lateral to the deep vessels in the neck and serve as a guide in locating the deep vessels at this point The internal jugular vein is then ligated as high as possible and severed

Most surgeons prefer to save the spinal accessory nerve if possible. It is picked up in the posterior triangle of the neck, as the dissection is carried upward and followed up through the sternomastoid muscle and leads the surgeon to the upper portion of the internal jugular vein In those cases in which the nerve has been accidentally injured or has been cut because of its proximity to tumor pain has been an important postoperative symptom The loss of the spinal accessory nerve causes paralysis of the trapezius muscle with shoulder drop Patients experience considerable pain for several months after the operation which is relieved by carrying the arm in a sling while they are at home or while sitting by resting the elbow on the arm of a chair (For further details see the section on composite operation.)

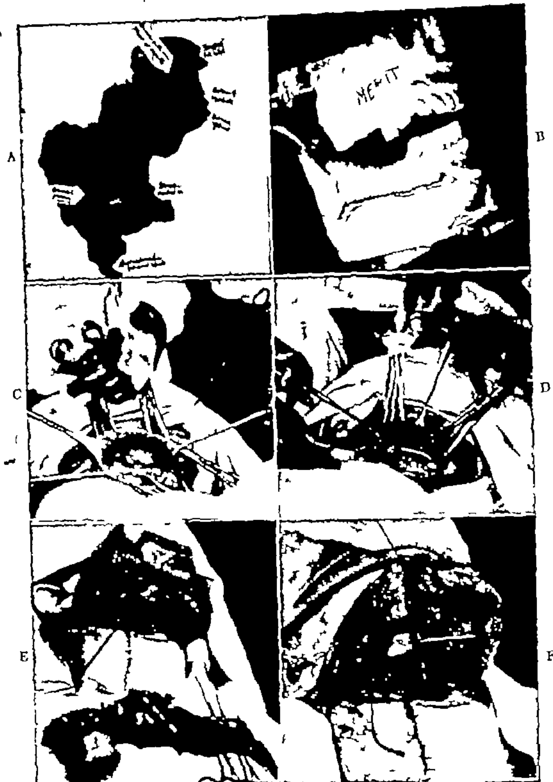


PLATE VIII

A. Specimen of block resection of carcinoma of floor of mouth including section of mandible and deep nodes of neck all in continuity

B Stone cast of patient whose specimen is shown in A with acrylic saddle splint to hold posterior fragment downward and backward Inserted at operation.

C. Operative exposure of large fibro-osteoma of right mandible, involving portion of alveolar ridge mucosa.

D Same patient as in Fig. C, with tumor removed subperiosteally Oral cavity closed and stainless steel bar inserted for fixation. Wound closed without drainage.

E. Operative exposure of composite resection for carcinoma of floor of mouth, involving mandible. The specimen in foreground includes right half of tongue, mandible section, and nodes of neck. The remaining split section of tongue and ends of mandible are evident. The lined flap above is to be swung down into position to close oral fistula.

F Same patient as in Fig. E. Oral fistula is closed and the mandible is fixed by a stainless steel bar Note that the lower part of the neck was closed before entering mouth. Patient healed without fistula.

The wound is closed in layers with interrupted black silk sutures in the subcuticular tissue and skin A drain is brought out through the lower end of the vertical limb of the incision A through and through rubber tissue drain is placed from the posterior end of the horizontal incision back of the ear to the anterior end in the midline of the chin, allowing drainage posteriorly while the patient is on his back for the next twenty four hours and anteriorly when he begins to sit upright or get out of bed The portion of the drain extending out of the back of the wound is cut on the second or third day and the drain gradually pulled out of the anterior wound

*A Composite Operation for Radical Neck Dissection and Removal of Cancer of the Mouth**

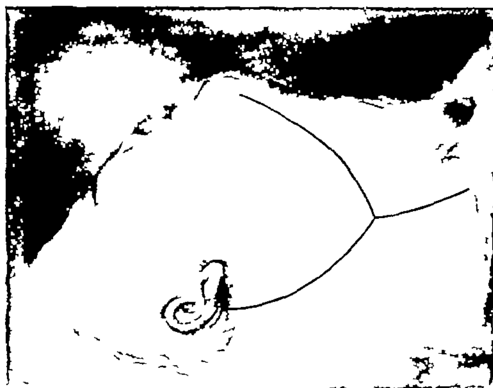
In the past surgery of cancer of the oral cavity and metastases, for the most part, has consisted of some form of removal of the primary lesion or radical resection of the node-bearing area of the neck, either in one or two stages. Since Kocher, in 1880 (quoted by Butlin. See Chapt. IX) there have been individual attempts to remove the primary lesion in the mouth, together with the lymphatic nodes in the neck. Semken (1932) also reports similar operative procedures planned for this block dissection of the lymph nodes, together with the primary site in the oral cavity As a rule, however there has been little attempt to remove the floor of the mouth through which cancer cells necessarily pass to reach the lymph nodes. Through the years, occasionally surgeons have resected *en bloc* the cervical lymph nodes and primary growth at one operation taking in all of the tissues through which metastases occur Ward s first attempt was in February 1932 (see Fig 578) This man was followed for two years without recurrence His primary lesion was on the lower left jaw just in front of the angle a site where cancer has a notoriously bad prognosis. Other cases so operated were usually ones with extensive cancer of tongue, floor of mouth, and gingiva, or metastatic masses attached to the mandible Skin involvement resulted in a large defect remaining after operation, requiring secondary closure.

* This clinical investigation was aided in part by a grant from the American Cancer Society

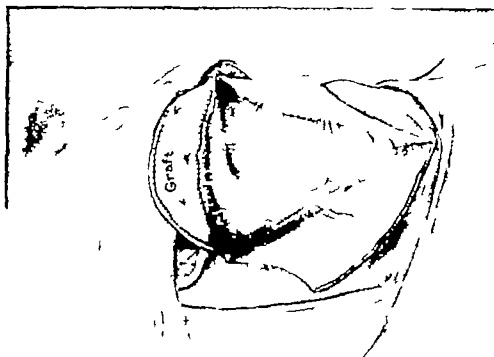
In 1945, Henry Harkins and Ward performed an extensive composite operation for carcinoma of the right buccal mucous membrane which involved both upper and lower alveoli The neck dissection began at the clavicle and was carried up to and included the upper alveolus and floor of the antrum. The patient died in the hospital with recurrence. Much was learned from this operation which helped in planning future ones In 1946 we assigned John O Robben, then a fellow of the National Cancer Institute and studying at the Medical School of the University of Maryland, to devise improvements in this operation. He made very interesting anatomical pathological, and clinical studies. In reviewing the literature, Robben found that Polya and associates, in 1902, published an anatomical study of the lymphatics of the head and neck This work was later confirmed by English anatomists. Their investigation showed that in 50 per cent of normal individuals the lymphatics of the tongue and floor of the mouth pass through the periosteum of the mandible on their way to the lymph nodes in the submaxillary triangle accounting for the frequency of early attachment of metastases to the jaw and also emphasizing the need of resection of the periosteum or the entire horizontal ramus of the mandible, whenever there is malignant involvement of the floor of the mouth close to the jaw

OPERATION

Anesthesia. A tracheostomy is essential both during the operation and for five to seven days postoperatively The tracheostomy is performed preferably at the beginning of the operation either under local or pentathol anesthesia. General anesthesia is begun with sodium pentathol intravenously which is continued throughout the operation supplemented by nitrous oxide and oxygen administered through the



A



B

Fig 564 Composite Operation Technic I

A. Neck incision used in composite operation for removal of the lymph node bearing fascia of the anterior and posterior triangles of the neck together with the primary lesion in the oral cavity or lateral pharyngeal wall. By having the junction of the "Y" low in the neck, there is less likelihood of a fistula

B First stage of composite operation. Skin flaps are turned back and a split thickness graft applied to the under surface of the upper flap to form the floor of the mouth after the second stage has been completed (See text for variations in this operative technic)

tracheostomy tube. Curare is given as indicated. Any explosive mixture as ether nitrous-oxide and oxygen is contra indicated for electrosurgery is used to coagulate clamped vessels and for dissection in the mouth

Skin incision. At first we used the traditional "T" or laterally placed "H" incision Both of these incisions leave a three-cornered closure toid process with the convexity extending at least below the hyoid bone preferably about two-thirds of the way down the neck. From the middle of this incision, a second vertical one is dropped to the middle of the clavicle When the neck is closed the corners of three skin flaps are far enough down the neck that the skin heals directly to the neck muscles.

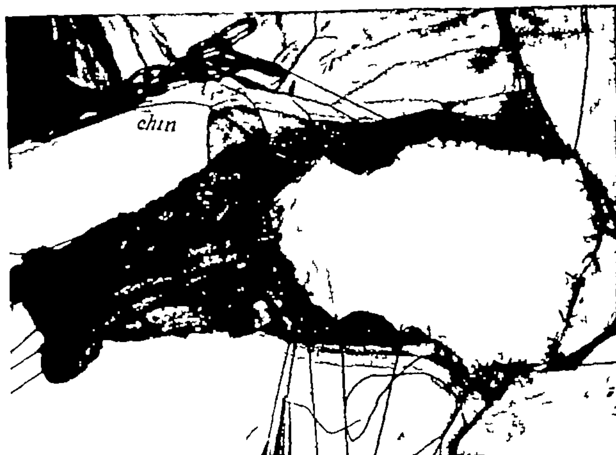


Fig 565 (A) First stage of composite operation. Technic II, lined apron flap

A A long vertical neck skin flap has been raised and turned over the cheek. The flap is based over the mandible. When it is contemplated to resect the jaw the base is higher in the cheek above the mandible than when the bone is not removed The width of the flap varies with the proposed area of mucous membrane loss. Usually the width of the flap is from the angle of the chin to the angle of the mandible. Its length will vary with the amount of skin necessary to replace mucosal loss, but usually extends to just above the clavicle. The raw surface of the neck is covered with a temporary split thickness skin graft to prevent serum loss and infection until the second stage of the composite operation a fortnight later

in the submaxillary region which led to delayed healing in several cases and to a fistula in four patients who had cancer of the pharynx or tonsil All but one of the small fistulas developing at this point in patients with mouth cancer healed spontaneously after several days or weeks A modified Kocher "Y" shaped incision (Fig. 564 A) suggested by Milton Edgerton, is often useful A curved incision is made *from the midline of the chin back to the mas-*

Edgerton later suggested that the incision be made at a preliminary operation say two weeks prior to the resection, and at this time the upper flap be lined with a split thickness graft (Fig 564 B) This epithelial lining of the flap makes possible more or less reconstruction of the floor of the mouth preventing scar tissue from causing too much disfigurement and fixation of the tongue, with consequent difficulty *in talking (Technic I)*

More recently Edgerton improved the lining of the flap (Technic II) The composite operation is carried out in two steps The first step consists of raising a long vertical neck flap with the pedicle at the upper end overlying the mandible (see Fig 565 A) In the illustration the flap is turned up over the cheek and the raw surface covered with a split thickness graft The lower end of the pedicle flap is turned under to form a full thickness apron which eventually becomes the floor of the mouth (Fig 565 B C D) In figure 565 B a drain is passed between the flap and the turned under apron forcing the circulation through the upper end of the apron only Figures 566 A and B show the patient ambulatory between the operations. Figure 566 B is taken from the posterior aspect to show how the apron is attached above In those cases where the mandible is to be saved, the tip of this apron can be anchored to the periosteum of the mandible on the lingual side To do this, the mylohyoid muscle is severed at its origin on the jaw and the soft parts of the submaxillary triangle dissected away from the jaw up to just beneath the mucous membrane of the floor of the mouth The mouth is not opened at this time After seven days the apron portion of the graft is cut away from the main pedicle with one or two delays. The patient is now ready after fourteen days for the complete composite operation.

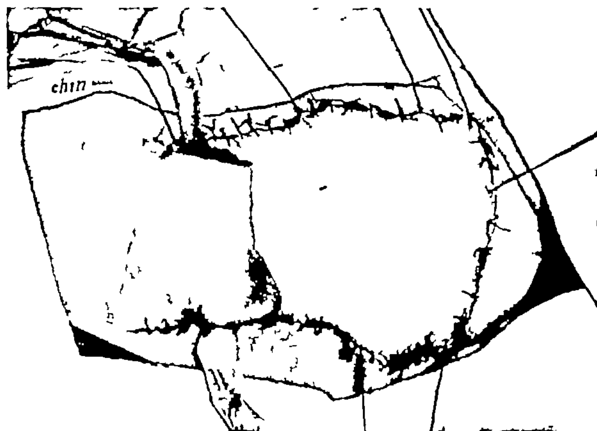


Fig 565 (B)

B Neck flap has been turned under on itself to form an apron flap and the distal end sutured high under the base when jaw is to be resected In this case the jaw is not to be resected the apron flap is sutured to the periosteum on the lingual side of the mandible high up under the mucous membrane of the floor of the mouth after cutting the mandibular attachment of the mylohyoid muscle (See Figs 565 C and D)

At the second stage the split thickness graft (B in Fig 567) applied at the first operation as a temporary covering to the raw surface of the neck is removed with the specimen. The com-

posite operation, or pull through operation, as required by the case in hand is now carried out, as described in subsequent paragraphs.

attached to the skin for better circulation, unless there is close attachment of the meta static mass to the platysma muscle

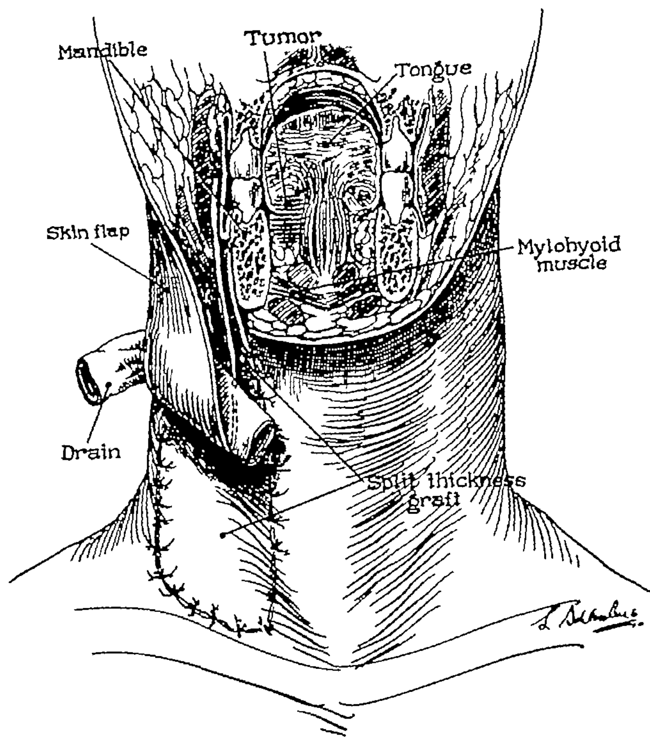


Fig. 563 (C)

C Schematic sagittal section showing attachment of apron flap beneath base of neck skin flap. Apron flap created by turning neck flap on itself Split thickness graft covers raw surface of neck cervical fascia and platysma muscle Cigarette drain between neck flap and apron flap preventing kinking and aiding in forcing circulation through distal end of apron flap

Neck Dissection. The skin flaps are dissected back. As a rule the platysma muscle remains

The dissection is begun from below and continued up in the usual manner taking the

sternomastoid, omohyoid muscles, and jugular vein. The jugular vein is cut between four ligatures of medium silk, leaving two medial

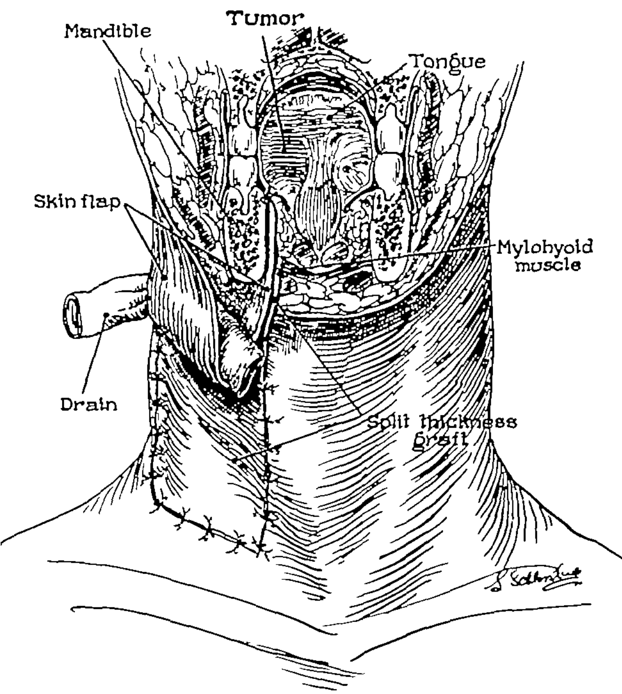


Fig 565 (D)

D Schematic sagittal section showing attachment of apron flap to periosteum of lingual side of mandible This method is used when mandible is not to be removed

and two distal (Fig 568 A) Care is taken to identify and save the spinal accessory nerve unless directly surrounded by metastatic tumor The external carotid artery and/or its branches are doubl\ ligated and severed to reduce hemorrhage. The posterior belly of the digastric and st\lohyoid muscles may be taken or left at the discretion of the operator The ligaments of the muscles are cut at

their attachment to the hyoid and lifted back, exposing the jugular vein and carotid sheath up to the base of the skull If no metastases are found here (not uncommon when the growth is far back in the mouth), and if the muscles are free from adherence to the node-bearing fascia, they may be saved and re sutured at the end of the operation to cover the internal carotid artery The dissection is where the omohyoid muscle lies external to the great vessel)

An alternate method of dissecting up the neck is to continue along the anterior border of the trapezius muscle, cleaning out the posterior triangle of the neck first. This technic was emphasized by Robben during his ana tomical studies already mentioned By this approach the pharyngo-maxillary space is



Fig 566 Patient between first and second stages of composite operation

A Lateral view

B Posterior view showing neck flap turned under and distal end attached high up, in this case to the periosteum of the lingual side of the mandible. Split-thickness skin graft covers raw surface. Final result Fig. 572.

now carried up to the midline in front along the anterior belly of the digastric muscle. This muscle may be saved also in some cases together with the geniohyoid muscle, to give support to the hyoid bone

(The digastric muscle in the upper part of the neck serves as a guide to avoid injury to the jugular vein or carotid artery since these two vessels always lie beneath the muscle This anatomical relation is a great help in dissecting out adherent masses. A similar ana tomical relation is present in the lower neck reached from the back, making it possible to remove the tumor and metastatic node-bear ing area from the posterior aspect and then move forward (Fig. 568 B) Heretofore, most of the neck operations were done in an anterior to posterior direction As the sternomastoid muscle is dissected up the neck, the spinal accessory nerve is found emerging from its posterior border and followed through the muscle to its emergence from the skull alongside the internal jugular vein. The main trunk of the nerve is preserved if possible that is, if

not included in the metastatic mass, while the branch to the sternomastoid muscle is severed Following the spinal accessory nerve in this manner is an aid in locating the upper portion of the internal jugular veins (Fig 568 B) While this dissection is being carried out a helpful maneuver is to cut the sternomastoid muscle end of the jugular vein close to where it emerges from the skull Four ligatures of medium silk are placed around the jugular vein and the vein is severed between the two middle ligatures. If the posterior belly of the digastric muscle and stylohyoid muscle are uninvolved by growth or not adherent they are spared

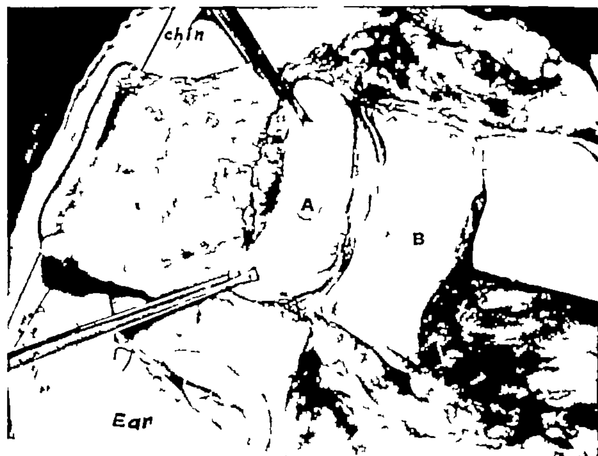
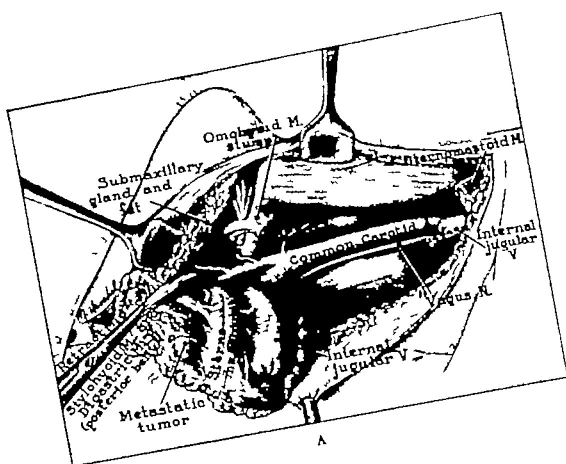


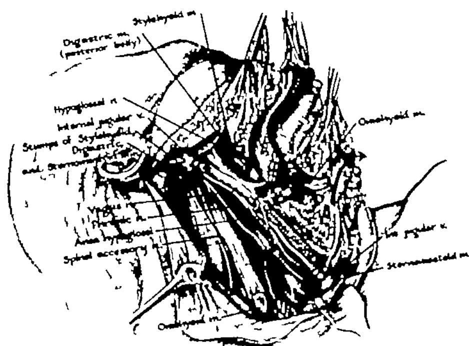
Fig. 567 Beginning of second stage of composite operation. Apron flap "A" is to be turned medially at end of operation and sutured to base of tongue and remainder of floor of mouth to rebuild floor of mouth. Mucosa of dorsum of tongue may be sutured to edge of apron flap or the cut surface of midline of tongue may be left to granulate The latter procedure does not bind the tongue so tightly to the apron flap and allows more mobility of tongue as the scar following electrosurgery is quite soft Tip of tongue is reconstructed by bringing together the mucosa of upper & lower surfaces with interrupted sutures of 00 chromic catgut. Split thickness flap "B" is taken along with the specimen

from its attachment to the mastoid process increasing the operative room in the posterior upper part of the neck As the sternomastoid muscle is lifted forward the origins of the posterior belly of the digastric muscle and the stylohyoid muscle come into view their fibers run in a more horizontal direction than those of the sternomastoid muscle and overlie the upper end of the jugular vein These muscles are cut and lifted forward exposing the upper and re-sutured at the end of the operation otherwise they are taken. The dissection is then carried anteriorly at a safe distance from the metastatic mass and primary tumor

Resection of the Jaw While developing this operation it was found that when the jaw had to be removed because of invasion or attachment of the primary growth or metastatic mass to it there was excellent exposure of the oral cavity back to and including the



A



B

Fig. 568

A Neck dissection completed from clavicle up to the digastric muscle which has been cut and turned back. Jugular vein tied and cut

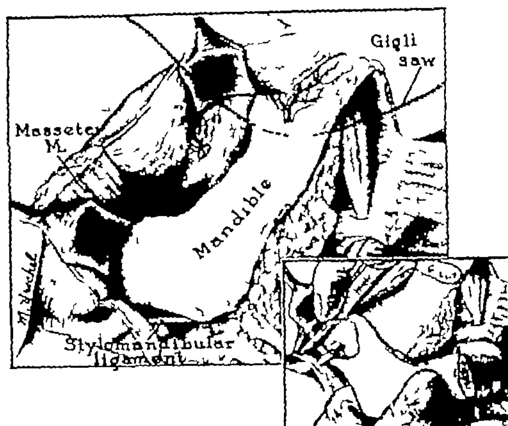
B Neck dissection posterior approach The dissection has been carried out from the clavicle up the neck, dissecting out the posterior triangle first and turning the specimen forward. The jugular vein is approached from behind by identifying the spinal accessory nerve and tracing it upward through the sternomastoid muscle to the jugular vein An important landmark is the posterior belly of the digastric muscle whose fibers run more horizontally than the sternomastoid muscle and protect the upper end of the jugular vein By cutting the digastric muscle a higher resection is possible Often lymph nodes are found beneath the digastric muscle This approach also allows access to the pharynx after resection of the jaw more readily than from the anterior approach as seen in Figure 569 A and B

pharynx It seemed to us worthwhile to sacrifice the jaw on the affected side in order to approach growths that are far back namely in the posterior part of the tongue tonsils, or pharyngeal wall If the disease is limited to the tongue floor of the mouth or the jaw only the horizontal ramus is removed To secure adequate exposure in several cases we have not hesitated to take out the entire half of the mandible The excellent exposure obtained and the consequent ease of removal of the primary growth floor of the mouth and neck nodes en masse offsets the disfigurement caused by the loss of the bone (see Fig 351) Comparing with radical breast operations, the removal of the mandible to reach the oral cavity and pharynx is like removal of the pectoral muscles to clean out the axilla Then too modern prosthetic appliances reduce the disability formerly obtained at times, by holding the unoperated side of the jaw in alignment (see Chapt XXI) Stripping the periosteum from the bone facilitates the detachment of the muscle as well as renders damage to the large vessels especially the internal maxillaries in the pterygoid fossa, less likely The bone is severed at or near the midline with a Gigli saw and then disarticulated at the temporomandibular joint (Fig 569 A)

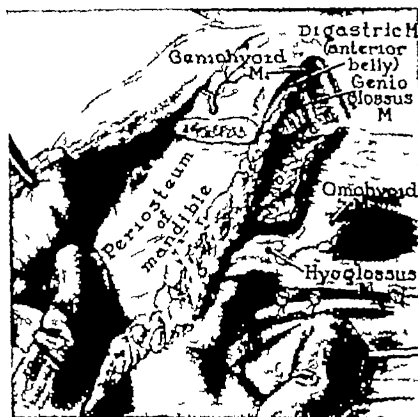
Dissection of the Tongue Muscle. This part of the operation is important the technic having been developed by John O Robben after careful anatomical studies The posterior belly of the digastric muscle has already been detached at the hyoid bone and laid back. If free from adherence to the growth it is resutured at the end of the operation if not it is taken with the specimen The anterior belly of the digastric and geniohyoid muscles are left only if free of disease and are far enough away from the growth to be certain of no recurrence as they serve to support the hyoid bone The mylohyoid muscle is severed at its attachment to the hyoid bone (Fig 569 B) Next the genioglossus muscle is cut at its attachments to the genial tubercle and hyoid bone and the hyoglossus muscle may or may not be cut at the hyoid bone depending on how far back the primary growth has extended Severing it however, gives better exposure and a wider margin of safety The mouth is now entered by an incision in the buccal mucosa above the mandibular periosteum and as long as necessary for adequate access to oral cavity and pharynx. The tongue can now be delivered through the wound by a traction suture in the tip (Fig 569 C) Two traction sutures of medium silk, one on each side of the midline guide the incision down the midline of the tongue. With a strong electrosurgical cutting current the mucous membrane of the floor of the mouth and the tongue are slit back to a centimeter or more beyond the indurated area of growth allowing the genioglossus, hyoglossus, and styloglossus muscles, which have been cut previously to come away with the mass. While cutting across the hyoglossus muscle the pharynx is not entered unless the growth is far enough back to demand removal of part of the pharyngeal wall. If the growth is forward and the pharyngeal wall is not involved healing is much quicker if the pharynx is not opened. We have had primary healing of the pharyngeal wall (patient shown in Fig 351) but in some cases there has been delayed union.

The operator now turns his attention to the posterior part of the upper neck, unless this has been previously dissected free, as described above

When the growth involves the tonsils and lateral pharyngeal wall the stylohyoid styloglossus and stylopharyngeus muscles, and stylomandibular ligament are freed from the styloid process. As much of the internal and external pterygoid muscles are taken as necessary Here the internal maxillary artery is ligated with medium silk at its entrance to and exit from the pterygoid fossa (Fig 569 D) The entire pterygoid fossa requires cleaning out when involved by extension of the cancer The line of cleavage then follows the pharyngeo-maxillary fascial plane and the prevertebral space is entered and followed to the midline The pharyngeal mucosa is severed horizontally at a safe level above the disease As much of the soft palate is taken as is necessary The



A

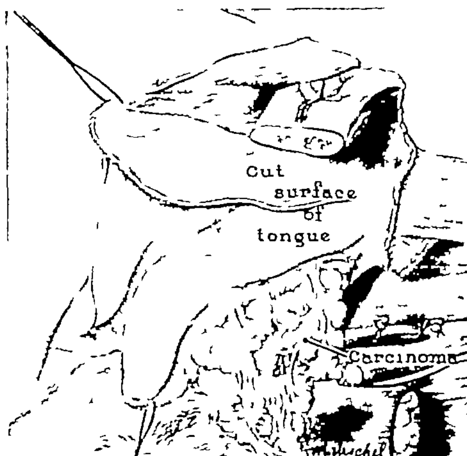


B

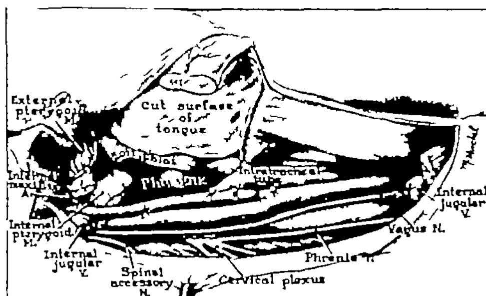
Fig. 569 (A–B)

A After neck dissection, the mandible is stripped of the periosteum and cut with a Gigli saw The jaw is then disarticulated at the temperomandibular joint (see Insert)

B Cutting floor of mouth and tongue muscles at their attachment to the hyoid bone.



C



D

Fig. 569 (C–D)

C. Tongue being slit down the middle. The resection of the tongue and floor of the mouth may be from the front or the back, depending upon where the oral cavity or pharynx was opened.

D. View of mouth and pharynx after removing tongue, tumor and nodes of the neck.

pharyngeal mucosa is then incised vertically and forward to meet the incision previously made in the tongue allowing removal of the entire specimen en masse Hemostasis is obtained by ligature or electrosurgery, as required. When the disease has not reached the tonsil, but remains confined to the tongue, floor of the mouth or jaw or all three, the line of



Fig 570 (A–B)

A. Lateral view of gross specimen of limited composite operation where the floor of the mouth, half the tongue, jaw and submaxillary lymph nodes down to the hyoid bone were removed in one mass. (a) Mandible (b) tongue (c) floor of mouth (d) tonsil (e) carcinoma (f) pharynx (h) submaxillary salivary gland (i) lymph nodes.

B Medial view of specimen shown in Figure 570A letters indicate structures as in Figure 570A.

cleavage is established more anteriorly leaving the tonsils pillars lateral pharyngeal wall, and palate intact.

Closure. Any rent in the pharyngeal wall is closed if possible with fine chromic catgut When much loss of pharyngeal wall can be anticipated preoperatively technic II should be used to prepare a lined flap The lining is fitted to the mucosal defect in the pharynx and mouth

I It is important to close off the lower neck tightly below the hyoid and base of the tongue to prevent saliva and infection from the mouth draining down the neck A row of interrupted black silk sutures tack the upper margin of the lower neck flaps to remaining fascia, muscles and hyoid bone The lower neck is usually closed before the mouth is entered, so that the



Fig 570 (C)

C. Gross specimen of composite operation Mandible was disarticulated as shown Primary lesion was in the floor of the mouth and tongue.

lower neck is entirely walled off from the possible infection above The vertical incision is then closed with two layers, subcutaneous and cutaneous, of black silk interrupted sutures A Penrose drain is placed in the lower end of the incision Appearance of patient closed by this method is shown in Fig 351

Formerly a large iodoform pack was placed in the dead space in the mouth, a suture at

tached to one end of this pack being brought out through the mouth No packing is necessary when the inner side of the cheek-neck flap is lined with skin The edges of the lining are sutured to the base of the tongue and mucosa in suitable manner using interrupted fine chromic catgut The horizontal incision is closed tightly with two layers of interrupted black silk sutures

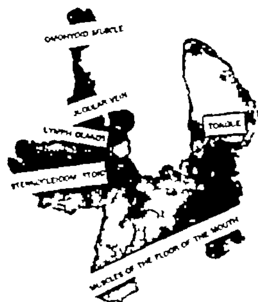


Fig 570 (D)
D Specimen of pull through composite operation. Jaw was not resected

II The closure of the wound after developing the lined flap is carried out as follows

The apron flap (A Fig 571) is swung medially and sutured to raw surface of base of tongue with the skin side up making a new floor of the mouth In figure 567 Allis clamps are attached to the distal end of the apron flap this end being rotated and sutured to the base of the tongue The flap is trimmed to fit the defect in the mucosa of the oral cavity and sutured to the edges of the oral mucosa and muscles of the base of the tongue with subcuticular and submucous sutures of 0 chromic catgut completely closing the oral cavity The pedicle flap is now brought as far down the neck as its length will permit and sutured over the apron flap (see Fig 571) A Penrose drain is inserted beneath the anterior edge of this pedicle flap The skin of the neck is then sutured so as to close as much of the neck as possible The remaining raw surface is then covered with a new split-thickness graft as illustrated in figures 572A and B, taken two months after operation This patient went out of the hospital to the movies on the night of the eighth day following the composite pull-through operation. The wound healed per primary without leakage from the mouth

The cheek and floor of the mouth thus reconstructed are thick enough to permit insertion of a steel bar to hold the stumps of the mandible in normal position after the method described by Louis T Byars. This steel bar passes between the two layers of full thickness skin in the flap (see Chapt XXI)

Figure 573 A and B are of a patient suffering with carcinoma of the left lower gingiva which had involved the mandible He was previously treated with x ray therapy through an intraoral cone and externally through the skin as a preoperative measure. Subsequently a fistula developed as shown This made it necessary to place the apron flap rather far back, so that the anterior part of the wound had to be closed by bringing the skin edges together without lining. Prior to operation a prosthesis had been constructed (see Chapt XXI) with clasps to fasten to the remaining teeth on the right mandible A guide plane was attached to maintain proper alignment of the right mandibular fragment after resection of the left side The prosthesis projected along the left buccal surface to hold the soft parts in approximately normal position while healing. Figures 574 A, B were taken three weeks after first operation A temporary fistula developed in front of the flap but closed spontaneously after trimming down the posterior end and the lower margin of the prosthesis to relieve pressure and allow the soft parts to fall together more completely Figures 575 A and 575 B were taken four months after figures 574 A and 574 B Figure 576 taken at the same time shows the alignment of the jaw with the prosthesis out

Slaughter et al. (1949) described a com

Fig 571 Operative wound now ready for closure Clamp in center holds mucosa of base of tongue. Apron flap. A" will be sutured to defect of the lateral pharyngeal and/or oral mucosa and horizontally to base of tongue and remaining floor of mouth, closing the oral cavity The neck flap above "A will be brought down over the inverted apron flap "A" and sutured to the neck. The remaining raw surface of neck will be covered with a split skin graft.



Fig 572 (A–B)
A and B Front and lateral views of patient shown in Figure 566 two months after operation



Fig. 572 C

C. Specimen removed from this patient. Mandible not removed as primary cancer was limited to right side of middle third of tongue.



Fig. 573 A and B Front and lateral views of patient with primary carcinoma of lower left gingiva involving the underlying bone Skin is attached to mandible and is perforated by a sinus. The necessary loss of skin required modification of neck flap and allowed a residual postoperative sinus to develope which healed spontaneously



Fig. 574 A and B Front and lateral views of patient shown in Figure 573 between first and second stages of

bined operation for removal of intraoral cancer and the cervical lymph node bearing structures of the neck. They follow the standard neck dissection up to the inferior border of the mandible The lip is then severed in the midline and the mandible sectioned through the symphysis with a Gigli saw and swung lateralward. The intraoral operation is performed in a manner required to remove the primary growth with a wide margin A hemiglossectomy is done if indicated The amount of jaw resected varies with the position of the primary cancer When the cancer is far posterior the hemimandible is disarticulated, otherwise the horizontal ramus is removed Repair is accomplished by suturing the cheek flap to the mucosa of the intraoral soft parts in two layers if possible with interrupted catgut sutures. These authors do not employ the method of a lined flap

H. E. Martin (personal communication and quoted by Slaughter et al) and his coworkers have also been using a combined operation for removal of intraoral cancer and neck dissection for several years with gratifying results.

THE PULL THROUGH MODIFICATION OF THE COMPOSITE OPERATION

Mark Ravitch (personal communication) removed a large neurofibroma from the base of the tongue and submaxillary triangle by a method he termed a pull-through procedure Ravitch loosened the tumor in the neck first, then went into the mouth and dissected it free and pulled the tumor up into the mouth and removed it Following his example, we have removed several carcinomas of the tongue and floor of the mouth by a composite pull-through operation



Fig. 575 A and B Front and lateral views taken four months after Figures 574, A and B


Fig 576. Note alignment of the jaw maintained without prosthesis in patient shown in Fig 573.

This technic, less extensive than the full composite operation has a field of usefulness limited to carcinomas of the anterior two-thirds of the tongue and floor of the mouth Cases suitable for this operation must have a good margin of safety (1 cm. or more) between the posterior edge of the growth and the anterior pillar and also the lateral edge of

the growth and the jaw Attention is directed to reference previously made of Polya's investigation namely that in 50 per cent of normal individuals the lymphatics draining the tongue and floor of the mouth pass through the periosteum of the mandible, consequently the selection of cases for pull through procedure must be made with great care. The operation should be used only in early cases where neck dissection is completed the specimen is left attached to the tongue and the floor of the mouth The mylohyoid muscle is cut at its attachments, both to the mandible and hyoid bone, and the tongue muscles also freed at their lower insertions as in the composite operation. The lower skin flaps are sutured along the superior border of the hyoid bone and deep muscles and the vertical incision





Fig. 577 White man aged 67 with squamous cell carcinoma of the left lower alveolus. This patient was the first composite operation done by G E W February 15 1932 at the University Hospital Baltimore. In July and Sept., 1931 patient had radium treatment and electrocoagulation of the local area. There was recurrence. Operation consisted of radical neck dissection and electrosurgical resection of the floor of the mouth and jaw There was secondary infection which delayed healing. Nowadays this can be avoided by antibiotics. Patient was followed for three years and then disappeared By that time he had married a second wife a good sign that he was well.

it is reasonable to assume that there is no involvement of the periosteum. In one case, the periosteum was destroyed with electrocoagulation increasing the margin of safety A small area of osteomyelitis developed causing a long draining sinus and, later removal of sequestrum. The sinus then closed.

The operation follows the usual neck dissection including contents of submaxillary anterior and posterior cervical triangles, sternomastoid muscle and jugular vein After the closed. A Penrose drain is inserted as in the composite operation. The upper skin flap may be closed at this time or left open to permit adequate exposure for the pull-through procedure.

The operator then opens the mouth and places two stay sutures of black silk in the tip of the tongue, one on either side of the midline While making traction on these sutures the tongue is severed down the middle using a strong electrosurgical cutting current

The incision is carried through the tip of the tongue to the mucous membrane in the floor of the mouth in the midline anteriorly then around on the affected side close to the mandible and back beyond the growth at a safe distance By working first in the midline of the tongue and then the floor of the mouth alternately both incisions are carried deep into the soft tissues to the field of the neck operation liberating the entire specimen which is removed through the mouth, half the tongue floor of the mouth the node-bearing fascia of the neck, all in continuity

An iodoform pack is placed in the defect in the oral cavity, a black silk thread attached to the pack is brought out through the mouth. If not previously sutured the horizontal neck skin incision is then closed in layers with interrupted silk sutures.

Irradiation Therapy of Cervical Metastases

In the literature reference is made to "prophylactic treatment of cervical metastases In years gone by we gave this method of therapy a trial and learned that it is a waste of time and the patient's money, for to radiate the entire neck as a prophylactic measure does not concentrate the radiation energy in one area sufficiently to affect materially the metastatic cells In other words, the best one can accomplish in radiating the entire neck is to deliver approximately 2500 r units in air over it. However such radiation will not permanently affect cancer cells. It is well demonstrated by the experience of many radiologists and ourselves that the amount of radiation necessary to destroy cancer cells in the *primary lesion* where caustic doses can be given runs as high as 4000–8000 r units. Reference is made to Table 21 in Chapter IX on Cancer of the Tongue and Floor of the Mouth' When radiation is to be given to cervical metastases, it must be concentrated at certain areas where there is definite growth Here small sized cones are used through which 3000 or 4000 r may be given to the skin without permanent damage followed by implantation of radon seeds or radium element needles Some roentgenologists

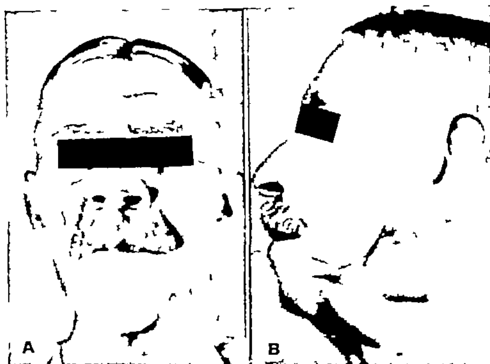


Fig. 378. Photograph of patient after composite operation consisting of dissection of upper half of neck, resection of the mandible floor of mouth, half of tongue tonsil, palate, and pterygoid fossa, followed by radium in the pterygoid fossa and x ray therapy externally (same patient as shown in Figure 351) Patient well three years following operation

have reported three and five year good results by the use of radiation therapy in malignant disease of the neck. Our experience does not confirm such results.

We limit the use of radiation therapy in the treatment of cervical metastases to the following groups of patients

1 Those having small nodes in the neck especially if there is only one or two in individuals who cannot withstand a radical neck dissection because of physical disability

2 Large inoperable node masses.

3 Metastases associated with a primary lesion which is, in all probability incurable

4 Metastases in the neck recurrent after operation.

Small nodes. The radiation treatment of small nodes in the neck, 2 or 3 cm in diameter and localized and discrete is as follows Roentgen therapy is first given. Treatment factors 35 TSD 0.5 mm. Cu 1 mm. Al 200 Kv 15 Ma 200–400 r per day three times a week until 3000–4000 r are given The cone used is suitable to the size of the growth. Such treatment allows limitation and concentration of the dose into the node Following this treatment radon seeds or radium element needles are implanted so that the tumor dose will reach 8000 r Surgical incisions over the nodes permit accurate palpation and implantation (see Chapt I)

Inoperable node masses are usually treated as a palliative measure Since these masses are quite large a 6 x 8 or 10 x 10 portal is used and the treatment carried to skin tolerance (about 2000–2500 r) Treatment factors are 200 Kv 15 Ma., 50 TSD filtration 0.5 mm. Cu 1 mm Al, 200 r per day three days a week until the desired amount is given, or up to skin tolerance Radon seeds or radium element needles are implanted.

Patients with rather large incurable primary growths **with cervical metastases** may be temporarily benefited by extra-oral radiation Often it is possible to direct the beam of ray through the metastases to the primary lesion. Treatment here is given very much as described in the previous paragraph

Recurrent neck metastases are palliated and sometimes held in check many months or years by adequate irradiation Again the technic is very much as that described in the paragraph on inoperable nodes

Prognosis

The prognosis of cancer of the oral cavity, pharynx, base of the tongue and lips is given in the several chapters dealing with these subjects In this chapter the prognosis of metastatic node involvement will be discussed. At best, the outlook for the patient who has definite metastases in the cervical lymph nodes is not good It is gratifying that the reported results in the literature are better in the last few years than formerly This is probably due to the fact that more cases are operated upon earlier and the operative technic is more extensive and thorough. Also radiation technic has been improved and a very definitely increased amount of radiation energy is delivered to the node-bearing area.

Ellis Fischel, in 1934 reported 112 cases from the surgical service of the Barnard Free Skin and Cancer Hospital with reference to the surgical treatment of the lymph nodes of the neck in carcinoma of the lips and buccal cavities. A simple unilateral neck dissection was performed in twenty-eight of these cases. Of these patients ten or 35 per cent were alive and free of evidence of disease five years or longer Six of these ten patients had microscopically proved carcinoma of the lymph nodes The same author in 1935 reported the end results in seventy four private cases operated on between 1918 and 1935 there were seven operative deaths, or 9.5 per cent. Causes of death were pneumonia, postoperative hemorrhage and uremia most of the deaths occur in cases which had definite metastases and were on the borderline of operability He explained that as operative technic is improved and the scope of the operation extended a higher percentage of cure is to be expected At

the time of writing, in forty four patients operated on by Fischel personally, there were 30 per cent alive and free from disease five years or longer Nine of thirteen cases showed lymph node involvement by the carcinoma on microscopic examination These thirteen were in the group of forty five which represented the 30 per cent cure rate They did not report the number of enlarged nodes proven histologically to contain carcinoma

Pfahler and Vastine (1934) reported the results of treatment by their improved method of irradiation of cancer of the mouth using radium in the mouth and radium pack over the nodes in the neck. These authors reported 157 cases with palpable lymph nodes and a recovery rate of thirty-seven or 23.5 per cent

Robert G Hutchison (1935) writes that possibly the most illuminating single point emerges in this connection (improvement of end results of carcinoma of the mouth) in the observation that 82 per cent of three year survivals were node free when first coming under observation ' The author goes on to state that good results of treatment of primary lesions were obtained in 81.8 per cent of the cases and relatively unsatisfactory results of treatment of the disease as a whole (27 4 per cent) were alive after three years. The discrepancy here arises primarily out of the resistance of the secondary deposits to treatment In dealing with these the radiation therapists have met so far with little success and, for the present at least the problem is a surgical one Unfortunately surgery itself can do little except in the early stages of metastases He suggests, for better improvement of results that the "prophylactic block dissection, the dissection performed before any enlarged nodes are palpable is not sufficiently exploited and that a wider resort to this measure would result in an improved prognosis. In this connection it will be noted that 44 7 per cent of the cases, node free when first coming under observation, developed metastases within the period of Hutchinson s review Moreover, it has been shown by this author and others that the ultimate expectation of node metastases is greatly in excess of this figure, especially in certain types Further, the percentage incidence of contralateral nodes in cases where nodes are already present on the side of the primary lesion would suggest that after careful treatment of the homolateral side, prophylactic block dissection of the other side may well be desirable. Certainly it can be replaced only by the most painstaking follow ups

Patterson (1941) reported five year results of block dissection of the lymph nodes in 178 cases of cancer of the mouth including the fauces and the base of the tongue The block dissection was carried out in the presence of palpable nodes (i e , excluding prophylactic block) Cases that could not be followed, those that died of primary lesion and those in which the nodes apparently were not involved were eliminated. He also excluded cases in which death was due to unrelated, intercurrent disease and in which the nodes and mouth were apparently well For analysis he used 142 cases with a five year salvage of 35 per cent in the whole group In a group of forty seven cases where the nodes were proved to be positive the five year salvage was 36 per cent.

Nuttall (1943) reported on 442 patients suffering from cancer of the oral cavity treated in 1932 and 1933 Twenty-eight per cent survived five years These cases were analyzed according to the advancement of the disease paying special attention to the effects of node involvement upon the prognosis. Of 220 cases without node involvement 46 per cent survived for a five-year period but only 12 per cent of the remaining 222 cases in which there were lymphatic metastases lived five years.

Since the prognosis of cancer of the mouth is so dependent upon the extent to which the disease has metastasized to the lymph nodes and since cancer of the floor of the mouth and tongue metastasize early we feel that the best results will be obtained by routine radical neck dissection in all cases of cancer of the tongue and floor of the mouth Our composite

TABLF 45

COMPOSITE OPERATION STUDIES

PATIENT	LOCATION	CLINICAL LYMPH NODE ENLARGEMENT	OPERATIVE INDICATIONS	OPERATION	PLASTIC PROCEDURES	DAYS IN HOSP	PATHOLOGICAL INVOLVEMENT LYMPH NODE	COMPLICATIONS	FOLLOW UP
F L B 43 yr male	Floor of mouth, rt	None	Extensive primary site uncontrolled by irradiation	Composite 2/25/47	None	49	None	Permanent fistula. Delirium tremens. Extensive metastases 3 mos. postop.	Died 10/22/47
A B.N 55 yr male	Mandible right	Submaxillary rt	Primary site uncontrolled by irradiation	Composite 3/7/47	Floor of mouth primarily closed	16	None	Temporary fistula. Recurrent abscess rt. submandibular	Recurrence primary site 12/1/48. Necessitating further irradiation followed by fistula. Living no disease Apr 50
M Mc. 60 yr female	Tonsl rt. Tongue rt. Floor of mouth, rt.	Submaxillary rt	Primary site uncontrolled by irradiation	Composite 3/26/47	Floor of mouth primarily closed	14	None	None	Living and well 8/1/49
O A 51 yr, female	Tongue rt	None	Prophylactic	Pull through (suprahyoid radical neck dissection) 5/8/47	Defect floor of mouth packed with iodoform	11	None	Osteomyelitis, rt. mandible Persistent small fistula	Metastases rt. neck 2/6/48 Implanted with radon seeds. Living and well Apr 50
J M., 58 yr male	Tongue rt. ant. faucial pillar rt. Tonsl rt.	None	Primary site uncontrolled by irradiation	Composite 5/20/47	None	66	Submandibular rt.	Miliary tuberculosis. Permanent fistula	Died in hospital from miliary tuberculosis
O C P 62 yr male	Tongue lft Floor of mouth, left	None	Primary site uncontrolled by irradiation	Pull through 5/21/47	Defect floor of mouth packed with iodoform	22	None	Temporary fistula	Living and well 8/1/49

G R 62 yr., male	Tongue rt. Floor mouth, rt. Tonsil rt. Pharyng. wall rt.	Submaxillary rt.	Primary site uncontrolled by irradiation	Composite 6/21/47	Skin flap from chest wall	180	Submaxillary rt.	Permanent fistula. Pneumoconiosis. Recurrence. Inanition	Died in hospital with aspiration pneumonia
E.S.K. 40 yr male	Tonsil, rt. Tongue rt Floor mouth, rt. Pterygoid fossa, rt.	Anterior cervical chain rt	Primary site uncontrolled by irradiation	Composite 6/25/47	Floor of mouth primarily closed	90	Anterior cervical chain right	Temporary fistula	Died—extensive recurrence 1/13/48
W B 60 yr male	Tongue rt	None	Prophylactic	Pull-through 7/11/47	None	24	None	Temporary fistula. Remainder tongue adhered to rt. gum	Living and well 8/1/49
J I L., 65 yr male	Floor of mouth, rt.	None	Recurrent after local excision and irradiation	Composite 8/6/47	Floor of mouth primarily closed	31	None	Poor mobility tongue	Mandible reconstructed 1/7/48 Living and well Jan. 50
J H 54 yr, male	Floor of mouth, left	Submaxillary left	Prophylactic	Pull-through 9/22/47	Defect floor of mouth packed with iodoform	27	None	Drug rash. Poor mobility tongue	Living and well Apr 50
J V 73 yr male	Tongue, left	None	Primary site uncontrolled by irradiation	Pull-through 2/7/48	None	22	None	Active syphilis	Recurrence with cross metastases to right neck 8/30/48
J R.Y 56 yr male	Base of tongue right	None	Primary site uncontrolled by irradiation	Pull-through 3/4/48	Defect floor of mouth packed with iodoform	25	None	Temporary fistula with recurrent abscesses	Living and well Apr 50 Fistula closed
[illegible]	Tongue rt.	Upper cervical	Prophylactic	Pull through 3/10/48	Defect floor of mouth packed with iodoform	20	None	Disorientation	Living and well 8/1/49

TABLE 45—CONTINUED

PATIENT	LOCATION	CLINICAL LYMPH NODE ENLARGEMENT	OPERATIVE INDICATIONS	OPERATION	PLASTIC PROCEDURE	DAYS IN HOSP	PATHOLOGIC INVOLVEMENT LYMPH NODE	COMPLICATIONS	FOLLOW-UP
H. 49 yr, male	Tonsil rt Base of tongue rt	None	Prophylactic	Composite 3/27/48	Unlined delayed chest flap to close defect floor of mouth	126	None	Temporary fistula closed by plastic operations	Living and well Apr 50
I C 63 yr male	Tonsil left Palate left	None	Primary site uncontrolled after irradiation	Composite 4/1/48	Lined delayed chest flap to close defect floor of mouth	69	None	Permanent fistula. Pterygoid abscess	Died in hospital with aspiration pneumonia 4/16/48 No tracheotomy
I R. 60 yr male	Tongue rt	None	Primary site uncontrolled by simple excision and irradiation	Pull through 4/11/48	Floor of mouth primarily closed	21	None	Diabetes mellitus. Excessive salivation Poor tongue mobility	Living and well 8/1/49
S 36 yr, male	Floor of mouth, rt	None	Prophylactic	Pull through 4/13/48	Floor of mouth primarily closed	18	None	Hyperpyrexia	Operative death (respiratory) 4/14/48
W 67 yr male	Buccal mucosa, rt Gum rt Mandible rt	Submaxillary rt Deep cervical rt	Primary site uncontrolled by irradiation	Composite 4/22/48	Floor of mouth primarily closed	25	Submaxillary rt. deep cervical rt	Temporary fistula. Esophagitis	Living and well 8/1/49
I J 60 yr male	Tongue rt Floor of mouth, rt	None	Primary site uncontrolled by irradiation	Composite 5/10/48	Lined delayed chest flap to close defect floor of mouth	228	None	Infection. Slough of graft. Multiple plastic operations	Died 8/25/48 following 8th plastic operation
M C 59 yr female	Undersurface tongue rt. Floor of mouth rt.	Submental glands	Recurred after electrosurgery Leukoplakia Local metastases	Pull-through 5/13/48	None	17	None	Dysarthria	Living and well Feb 50

A.T.M 63 yr male	Gum left. Floor of mouth, left	Submaxillary left. Deep cervical left	Pain primary site uncontrolled by irradiation. Local metastases Radio-osteonecrosis, mandible	Composite 6/9/48	Lined, delayed chest flap to close defect floor of mouth	30	None	Urinary tract infection	Died generalized metastases 11/23/48
G.E.F 56 yr male	Tongue, rt.	None	Prophylactic	Pull-through 10/14/48	None	21	None	Temporary fistula	Living and well 8/1/49
D.C.M 57 yr male	Floor of mouth rt.	None	Prophylactic	Composite 11/1/48	Lined neck flap to close defect floor of mouth	24	Cervical nodes	Temporary fistula	Living and well Apr 50
B.H 56 yr male	Gum, rt Mandible, rt. Submaxillary gland rt.	Submaxillary rt. Upper cervical, rt.	Disease uncontrolled by irradiation	Composite 11/6/48	Sliding lined pedicle flap to close defect floor of mouth steel bar fixation mandible	41	Skin and subcutaneous tissue, neck	Temporary fistula	Living with recurrence 9/1/49
R.S. 75 yr, male	Tongue, rt. Floor of mouth, rt.	Submaxillary rt.	Primary site uncontrolled by irradiation	Composite 12/30/48	Lined pedicle flap to close defect floor of mouth. Internal bar fixation mandible	68	None	Temporary fistula	Living and well 8/1/49
V.L. 47 yr female	Floor of mouth left. Ant. base of tongue	None	Prophylactic	Pull-through 1/6/49	Sliding lined pedicle flap to close defect floor of mouth	25	None	Respiratory obstruction	Operative death 1/8/49 No tracheostomy
R.D 53 yr., male	Tonsil, rt. Floor of mouth rt.	None	Prophylactic	Composite 1/20/49	Lined neck pedicle flap to close defect, floor of mouth	17	None	None	Cerebral accident—death 12th postop day 2/1/49

TABLE 45—CONTINUED

PATIENT	LOCATION	CLINICAL LYMPH NODE ENLARGEMENT	OPERATIVE INDICATION	OPERATION	PLASTIC PROCEDURES	DAYS IN HOSP	PATHOLOGICAL INVOLVEMENT LYMPH NODE	COMPLICATIONS	FOLLOW UP
V K 59 yr male	Tongue left	None	Primary site uncontrolled by irradiation	Composite 3/31/49	Lined neck pedicle flap to close defect floor of mouth. Steel plate mandibular fixation	41	None	Foreign body reaction to mandibular bar removal necessitated prosthesis to hold alignment	Living and well 8/1/49
F 62 yr male	Mandible left Gum left Floor of mouth left	Submandibular left	Primary site uncontrolled by irradiation	Composite 5/28/49	Lined neck pedicle flap to close defect floor of mouth	49	None	Tracheal bronchitis. Temporary fistula	Living and well Apr 50
S 60 yr male	Tongue left Floor of mouth left	None	Prophylactic	Pull-through	Lined neck pedicle flap to close defect floor of mouth	10	Respiratory distress first post op day	None	Death 1st postoperative day No tracheostomy
A C 54 yr male	Tongue right middle	Normal soft submaxillary and cervical	Prophylactic	Pull through with radical neck dissection 8/12/49	Skin flap lined 8/1/49	27	None	Skin over graft binding tongue to jaw postoperative accumulation of fluid under flap after returning home	Scar in mouth excised no evidence of disease Apr 50
D A M 40 yr male	Tip of tongue Ant floor of mouth	Submax. rt	Prophylactic for primary positive nodes, rt	Pull through 7/11/49 (rt radical neck, bilat suprahyoid dissection)	Lined neck pedicle flap to close defect in the floor of the mouth		Rt side of neck	Osteomyelitis. Portion rt. mandible resected Poor tongue function	No evidence of recurrence Apr 50

Operated on at Walter Reed General Hospital. History furnished by Col. Sam F Seeley Chief of Surgical Service

operation has been in the process of development for only three years therefore, it is too early to give any prognosticating figures (Table 45) Thirty three patients are reported in this table. Nine other patients have been operated upon since with no operative mortality These are too recent to be included here. In the beginning only patients with extensive disease were operated upon, consequently the results were less favorable More careful selection of cases has given better results. Nineteen patients are living without demonstrable disease from eight months to three years. Many have returned to their occupations one is a minister and preaches every Sunday with the aid of a public address system

There were seven hospital deaths one died on the twelfth postoperative day from a cerebral accident one died within three months after eight plastic procedures for reconstruction of the side of the face and neck. One died fifteen days postoperative from aspiration of the contents of a pterygoid abscess, and two succumbed suddenly on the first and third post operative days respectively These three deaths could probably have been prevented by a tracheostomy at the time of operation—now a routine procedure One patient died of miliary tuberculosis, obviously a poor selection for the operation. His cancer was very extensive and the operation was done as an extreme measure. The seventh death occurred two and a half months postoperative from aspiration pneumonia. This man had a wide open pharyngeal fistula

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Chapter XX

TUMORS OF THE SKULL

By
John C Glenn, Jr , M.D *

Bones of the head and neck are rarely the sites of primary tumor formation but they are commonly the locations of metastatic lesions. They may also be affected by tumors of the adjacent soft parts Primary tumors of the skull are found in less than 1 per cent of routine skull examinations. Fortunately the most common of these tumors is benign and furthermore is one which usually produces no symptoms This lesion is the osteoma Cholesteatomas and hemangiomas are next in occurrence [illegible] These latter lesions are benign [illegible] malignancies of any kind are rare [illegible] may manifest themselves [illegible] lesions and are easily differentiated [illegible] tumors. Among these may [illegible] Weber's syndrome [illegible] thyroidism leontiasis [illegible] Albers Schoenberg [illegible] anemia sickle cell anemia [illegible] osteomyelitis, rickets [illegible] hematoma etc.

It has been estimated by various authors that metastatic lesions to the cranium are seen in 0? per cent to 38 per cent of routine skull examinations Geschickter and Copeland estimate that 10 4 per cent of skulls are so affected This latter figure is probably more nearly correct but still may be a little high

Of the metastatic lesions it has been observed that breast and prostate are the most common source with carcinoma of the thyroid hypernephroma, and neuroblastoma being next in order These last three mentioned apparently show greater individual preference to metastasize to the skull than do the former It is rare for malignancies of the lung gastrointestinal tract or other systems to metastasize to the skull.

BENIGN TUMORS

Osteoma

PATHOGENESIS

As in most neoplastic diseases the pathogenesis of osteomas is unknown However in a series of eleven cases reported by Geschickter in 1936 eight attributed the onset of the tumor to a severe blow or fall

CLINICAL BEHAVIOR

It has been mentioned that osteoma is the most common bone tumor of the skull, but even so it is rare There is a tendency for this lesion to occur near the suture lines and more commonly in the frontal bone though any bone may be involved. They may be either multiple or single According to Geschickter's series the average duration of these tumors was about eighteen years, and they were more commonly seen between the ages of eighteen and thirty three

Usually the first sign the patient has of osteoma is the presence of a hard, immovable, painless swelling on the surface of the skull. In some of our cases osteomas have been incidental findings, the patient being unaware of their presence Usually they produce no symptoms unless by a strategic location or by their large size they cause pressure on some adjacent structure such as the brain or cranial nerves. They may also cause disfiguration which, again, in some of our cases was the reason for consulting a physician They may produce nasal obstruction or even encroach

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upon the normal volume of the cranial cavity In the later stages, there may be intracranial symptoms, such as headache, dizziness, or even epileptiform seizures.

ROENTGENOLOGIC FINDINGS

Commonly osteomas are circumscribed tumors of bone which may involve one or both tables. They may also appear as diffuse tumors arising in the sphenoid or temporal bones or in the orbito-ethmoid or orbito-maxillary areas These diffuse lesions produce tremendous thickening of the involved bone and are usually the type of tumor that gives rise to the most symptoms.

The appearance of the circumscribed osteoma is not difficult of recognition They appear as mound like projections from the surrounding bone and are of varying densities, depending upon the degree of differentiation Highly differentiated tumors are therefore composed of cortical bone and give the appearance of a homogeneously dense structure (Fig 579 A, B C) If they contain larger amounts of spongy bone, then their cortices are consequently thinner and may appear as perfectly normal bone Their cortices are continuous with the surrounding normal cortex. The spongiosa may be seen to be continuous with the adjacent spongiosa. There is a lack of any evidence of bone destruction However it is important to view spongy osteomas in a tangential projection, since in a direct or head-on view they may appear as areas of bone de-

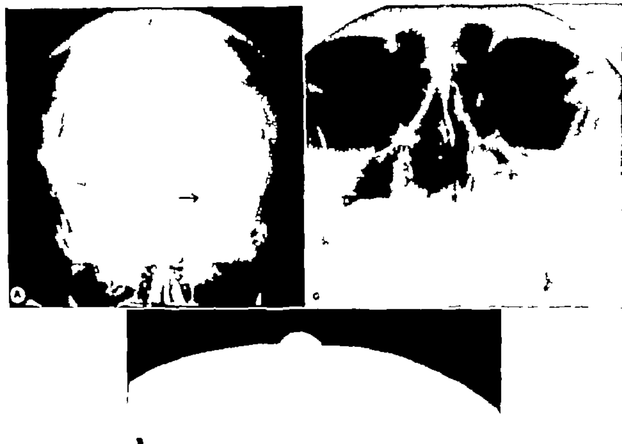


Fig 579

A. Compact osteoma adjacent to the left internal auditory meatus, producing no symptoms and found on routine skull films.

B Osteoma—a small compact, asymptomatic osteoma in the frontoparietal region in a 45-year-old, white female. There is a homogeneously dense projection of cortical bone above the surface of the outer table. No evidence of periosteal reaction or bone destruction.

C. Osteoma—31 year-old colored female with symptoms of sinusitis for 4 years. Small slightly spongy osteoma coincidentally found on x ray and at operation in the left ethmoid sinus. When these lesions are large differentiation from meningioma may be difficult

struction, thereby leading to a false impression.

Because of the difficulties so often encountered in distinguishing diffuse osteomas from the meningiomas, one must keep these two possibilities in mind Whenever an osteoma involves the inner table or both tables, particularly along the saggital or temporofrontal regions, meningioma must be considered In the basal areas, both wings of the sphenoid and the temporal squamosa may be affected.

The differentiation between osteoma and meningioma at times may be difficult However the typical meningioma produces changes which will indicate the correct diagnosis The type of osteoblastic reaction which is usually produced by meningeal tumors manifests itself by the radiating spicules of bone arranged at right angles to the tables of the skull. On close inspection of the film it can be seen that the inner and outer tables are still present though they are somewhat expanded and partially destroyed Cushing in *1922* indicated that meningiomas occurring along the sagittal regions of the cortex and in the temporofrontal meninges are more apt to produce bone changes than are meningiomas occurring elsewhere The spicule formations seen in meningiomas must be differentiated from the spiculation *so commonly seen in sickle cell or other* chronic anemias. However these latter are usually more extensive more marked, and generally occur in the younger age group than do the meningiomas.

HISTOLOGY

As mentioned, osteomas are formed depending upon their degree of differentiation largely of cancellous bone or of cortical bone. Histologically they exhibit a layer of cortical bone underlying a zone of connective tissue Beneath the cortical bone are trabeculae of cancellous bone which vary in vascularity and the amount of intervening fibrous tissue according to the degree of differentiation The more differentiated tumors show mature bone structure The spongy osteomas show a rather cellular vascular connective tissue which separates spicules of newly formed bone which are more or less surrounded by rows of osteoblasts.

TREATMENT

The treatment for osteomas is surgical which in the small osteomas is relatively simple Their removal can be accomplished by chiselling away the osteoma at its base The more diffuse *osteomas however may be very difficult in*deed to handle and justly belong in the sphere of the neurosurgeon In these cases, it may be impossible to remove the entire tumor and only such amount should be taken away that will accomplish alleviation of any symptoms.

Osteochondroma

Osteochondromas are rarely found in the skull and, when present most commonly occur around the base where some of the bones have their origin in cartilage. Traumatic hyperostoses are rare, and in some cases it may be difficult to distinguish these from a true osteoma.

Fibrous Dysplasia of Bone

A number of disease processes have been plagued by a multiplicity of names of which fibrous dysplasia of bone is a prime example

Lichtenstein and Jaffe (1942) in order to include all cases showing variations of the one theme with single or multiple lesions and to remove the obfuscation caused by multiple appellations, have suggested that the name fibrous dysplasia of bone be applied to all of them.

That fibrous dysplasia of bone is a disease entity separate from hyperparathyroidism (von Recklinghausen s disease of bone) and neurofibromatosis (von Recklinghausen s disease of nerves) seems well established even over the objections of several authors

CLINICAL BEHAVIOR

The cases described by Albright (1942) were associated with precocious puberty and areas of cutaneous pigmentation in young females. The bone lesions tend to be unilateral and seg-

mental in distribution with some apparent relationship between them and the areas of pigmentation These patients may also exhibit other evidences of endocrine disturbance, such as hyperthyroidism and premature skeletal growth and maturation There are also probably associated renal and cardiovascular anomalies.

The above description characterizes the most severe form of the disease according to Lichtenstein and Jaffe In only about 35 per cent of their cases was there pigmentation of the skin and only 22 per cent showed evidence of endocrine dysfunction

The less grave cases demonstrate only the skeletal lesions which may be multiple or single Multiple lesions too tend to be unilateral as in the cases described by Albright. This, however, is by no means the rule

These patients have pain deformity disability and spontaneous fracture depending on the degree of involvement Solitary lesions may cause no complaints, the lesion being discovered accidentally or a painless swelling may appear or a spontaneous fracture occur The onset is in childhood

ETIOLOGY

There is little doubt that fibrous dysplasia is a congenital developmental anomaly Lichtenstein and Jaffe particularly believe that the skeletal lesions are the result of a perversion of activity of the specific bone forming mesenchyme and hypothecate that perhaps hypothalamic abnormalities may account for the endocrine dysfunction.

Schlumberger (1946) described sixty-seven cases of monostotic fibrous dysplasia which he states is neither endocrine nor developmental in origin but is related to a variety of bone injuries with subsequent aberrations of healing. However the histologic picture and clinical course suggest ossifying fibroma The relationship of fibrous osteoma to fibrous dysplasia is not clear

LABORATORY FINDINGS

In cases with single lesions or with mild involvement blood laboratory findings may be within normal limits More advanced cases may show elevation of serum calcium and phosphatase proportional to the degree of bone involvement The serum phosphorus is not depressed and there is no increase in excretion of calcium.

ROENTGENOLOGIC FINDINGS

The solitary lesions are difficult, if not impossible, to identify definitely roentgenologically They may be confused with bone cyst, enchondroma, giant cell tumor ossifying fibroma, etc. In Schlumberger's sixty-seven cases the correct diagnosis was not suggested in a single instance by the roentgenologist

When there are multiple lesions in a long bone there may be several rather discrete rarefactions or there may be larger areas containing mottled or patchy areas of calcification depending upon the amount of calcification occurring within the fibrous tissue The cortex is expanded and thinned and there may be deformities and/or fractures. Except following fracture or other secondary interference there are no evidences of periosteal reaction There is usually some evidence of bone repair or bone production which Albright says is an essential feature in the syndrome he described. The surrounding bone appears normal, an aid in differentiation from hyperparathyroidism.

Radiographs of skull lesions are indeed confusing According to Pugh (1945) the changes seen in the vault, occiput, and mandible resemble the changes present in the long bones, but in the frontal, sphenoid, and maxillary bones the lesions are sclerotic. In the latter locations in his ten cases (5 male, 5 female) the bones were thickened, producing facial asymmetry and the paranasal sinuses were partly or completely occluded He states that the changes are not unlike those occurring in leontiasis ossea and suggests a relationship

Most authors describe pagetoid lesions in the skull The outer table is more expanded than the inner and is thinned The areas of decreased density contain irregular patches of re-ossification producing the cotton wool appearance seen in Paget's disease The absence of radiating

spicules of bone and fewer symptoms serves to differentiate this lesion from meningioma of the "en plaque" type.

Of Schlumberger's sixty-seven cases fourteen had skull lesions maxilla seven calvarium five and mandible two

PATHOLOGY

Grossly the lesions are grayish white to yellowish white and are gritty, firm and resilient There may be a few small cysts containing amber fluid small islands of cartilage and other areas of increased vascularity

HISTOLOGY

The varying degrees of fibrous dysplasia all present similar histologic pictures The occasional presence of a few foam cells has led to the mistaken diagnosis of lipoid granuloma or xanthomatosis. Lichtenstein and Jaffe state that such cells are purely secondary and have no significance nor do they indicate a relationship between these processes.

Microscopically there is connective tissue proliferation of small spindle cells in a loose or whorled fashion. There may be areas of poor cellularity containing much collagen. These latter areas are usually poorly vascularized, whereas the former may be well supplied with blood vessels. There is some osteoid formation showing a tendency to ossification which gives the grittiness noted on cutting specimens Some small patches of hyaline cartilage may be seen

TREATMENT

No form of treatment is specific. However the lesions usually become stabilized at maturity of the patient or may progress only slowly Except in the most severe cases a hopeless outlook is not warranted

Helfet and Ghormley and Hinchey have reported some improvement following treatment with aluminum acetate

Monostotic forms may be controlled by surgical excision or curettage and placement of bone chips in the excavation care being taken to completely remove the tumor Sosman (1945) stated that small doses of roentgen rays are effective. Albright says that they do not respond to radiation. We have had no experience with radiation treatment of these lesions.

Fibrous Osteoma

Fibrous osteoma is discussed fully in the chapter dealing with tumors of the jaws.

In the skull this lesion most commonly involves the bones of membranous origin and nearly always occurs in younger people. Usually they are seen in the diploe producing bone destruction affecting the outer table more than the inner There is bone repair evidenced by stippled or streaky calcification They may grow across suture lines Lesions to be differentiated radiographically are meningioma, osteomyelitis metastatic lesions and Paget's disease Usually history and other pertinent data will make the distinction clear

Giant Cell Tumor

PATHOGENESIS

The pathogenesis of giant cell tumor is unknown. However Coley (1949) expresses the opinion that giant cell tumors in the skull are actually examples of fibrous dysplasia containing some giant cells. After a study of 300 giant cell tumors in various skeletal and cranial locations, Geschickter felt that there was an intimate relation between pathologic giant cell proliferation and physiological processes of absorption in intracartilagenous bone since giant cell tumor is usually confined to intracartilagenous bones or to sesamoid bones which are derived from cartilage in tendon sheaths. It is indicated therefore that giant cell tumors should be restricted to those regions in the skull which develop from the chondrocranium. It has also been suggested that giant cell tumors may result from trauma, causing vascular defects with subsequent infiltration with giant cell osteoclasts.

CLINICAL FINDINGS

The location of the giant cell tumor apparently determines the presence or absence of symptoms and their type In the case indi-

cated in Figure 580 the tumor produced no symptoms until late in the course of the disease The tumor mass was discovered more or less accidentally by the patient's barber It was not until shortly before admission to the hospital that the patient began to complain of head aches, convulsions, and periods of irrationality There was also some vomiting These changes were apparently due to increased intracranial pressure produced by the growth of the tumor

ROENTGENOLOGIC FINDINGS

Geschickter states that these lesions usually produce a sharply demarcated area of bone destruction Figure 580 illustrates a giant cell tumor occurring in the occipital bone Apparently this lesion arose in the diploic spaces and has produced widening of the inner and outer tables of the skull with some destruction of trabeculae in the diploic spaces. There is no surrounding bone reaction and on close inspection it can be seen that there appear to be some rather coarse residual trabeculae passing through the tumor From the x ray alone, it would be very difficult to differentiate this lesion from a bone cyst or fibrous dysplasia.

HISTOPATHOLOGY

Grossly these tumors appear dark red or black and are of current jelly consistency They are hemorrhagic and friable Microscopic examination shows a stroma consisting of round cells and spindle cells interspersed with numerous multinucleated giant cells which are easily seen under low power There are also many blood spaces

If the giant cells contain a few small and sparsely scattered nuclei, one should suspect a malignant type of giant cell and consider that the tumor may be a true sarcoma

TREATMENT

The treatment of giant cell tumors is far from being a standardized procedure Surgery and radiation both have their enthusiastic supporters. Surgery of cranial giant cell tumors is preferable not only because of the fact that relief of symptoms would be immediate but also to establish a definite diagnosis. The amount of radiation which is required to adequately treat a giant cell tumor is not such that there would be brain damage or even permanent epilation of the scalp, but it is known to radiologists that radiation treatment of giant cell tumors produces several changes which are normally expected. It has been noted



Fig 580 Benign giant cell tumor—occipital bone 7-year-old white male in perfect health until two months prior to admission when while having a haircut his barber noted a marble-sized lump on the back of his head. Lump slowly increased in size though it remained asymptomatic until one month later when at 4 o clock one morning patient had severe bifrontal headache and delirium. Since then similar episodes have occurred every other day associated with vomiting. There were no motor symptoms. Examination showed a mass 4 inches in diameter in the occipital region which was rather firm at the margins, soft in the center, and tender This was removed surgically and treated postoperatively with x-ray because of a question of malignancy Final diagnosis Benign giant cell tumor Recent examination (2 years after operation)—defect filling in with new bone, clinically well. There is a large cystic area in the occipital bone, containing trabeculations, as do giant cell tumors elsewhere. Both tables are expanded and thinned. There is no bone reaction around the periphery of the tumor

that roentgen treatment of giant cell tumors produces what at first appears to be a rapid worsening of the disease Indeed for the first few weeks following treatment it may appear that the tumor is progressing rapidly However eventually recalcification within the tumor begins and healing progresses. This period of delay in relieving intracranial symptoms, due to a giant cell tumor of the cranium, might prove disastrous and is responsible for

our tendency towards the use of surgery in the treatment of this lesion

It is imperative that should radiation therapy be attempted surgical intervention should not be undertaken hastily following therapy as a bad outcome is to be expected. The patient in Figure 580 was treated surgically Because of a question of malignancy at the time of operation a postoperative course of radiation therapy was given When seen on the last checkup visit, he was perfectly well and entirely symptom-free two years following radiation therapy Regeneration of bone was evident Treatment factors were 200 KV 15 MA 50 cm TSD ½ mm copper + 1 mm. Al filter and doses of 200 r daily alternating two 6 x 8 cm tangential ports to a total of about 1500 r tumor dose



Fig 581 Angioma—31 year-old white male with history of trauma to the left forehead 7 years previously A small asymptomatic, hard swelling appeared, slowly increasing in size. Two months ago he began to complain of frontal headaches. Examination showed a firm 7 x 4 cm. mass, which was slightly tender at the margins. Roentgenogram shows a honeycombed-appearing area of bone destruction. There is no surrounding bone reaction Both tables are involved This is a typical sunray appearance similar to osteogenic sarcoma.

Angioma

Pathogenesis

Primary angiomas of the skull are of relatively rare occurrence A significant proportion of cases reported in the literature have a history of trauma The case illustrated in Figure 581 also apparently followed trauma

In a recent review of the literature Wyke added one case of his own to those already reported making a total of sixty-one cases of primary cranial angiomas A significant number of these indicated that local trauma appeared to be of etiologic significance.

Clinical Findings

Primary hemangiomas of the skull constitute about 10 per cent of the benign tumors. According to Wyke the average age of the sixty-one cases was 29.8 years with only fourteen being less than thirty years of age It was indicated that hemangiomas are three times as frequent in females as in males and are most commonly located in the parietal bone with the frontal bone next in order Clinically there is usually a history of trauma followed by the appearance of a hard lump on the head which may persist for months or even years before the patient seeks medical attention. Commonly the masses are not tender to pressure but may later become so For all intents and purposes, clinically they may appear as a small rounded osteoma. As time progresses however the patient may begin to complain of headaches increasing in severity as the tumor enlarges. As in the case of other tumors in the cranium, should the size of the mass become sufficient there may be secondary symptoms due to compromise of the intracranial space. Any other symptoms vary according to the location of the tumor

Histopathology

Wyke states that these lesions may be cavernous or capillary in type and that the capillary type is rare especially in the skull. Histologically the case in Figure 581 coincided with the picture Wyke describes. These angiomas are composed of large blood filled spaces intersected by bony trabeculae and are lined with large flattened endothelial cells The capillary hemangioma is composed of near capillary size vessels and contains fewer bony trabeculae and more dense fibrous tissue. None has been known to be malignant

ROENTGENOLOGIC FINDINGS

The hemangioma is typical in appearance and its diagnosis should cause no confusion Seen in profile, it demonstrates a radiating spicule appearance suggesting a honeycomb *seen from the side* (Fig 581) There is some evidence of widening of the cortices especially the outer table which seems to bulge outward. The outer table may be destroyed, but the inner table appears intact In neither projection (profile or direct) can any surrounding bone reaction be seen. In a direct head-on view, the lesion resembles the cut surface of sponge rubber again with no evidence of surrounding bone reaction.

TREATMENT

Hemangiomas of bone have been treated both surgically and by irradiation As Wyke says, in view of the relative ease with which surgical treatment is carried out at present, it seems that surgery may be preferable in easily accessible areas. Hemangiomas respond well to irradiation and in areas which are not easily accessible, or when operation is not without great risk irradiation may be preferable.

Hyperostosis Interna Frontalis

PATHOGENESIS

According to Pancoast Pendergrass and Schaeffer this condition is present in approximately 4 per cent of routine skull examinations. According to Yoltan and other observers, it is encountered more frequently in women than in men The etiologic agent is not known neither syphilis nor trauma play any part in its inception Some clinicians feel that hyperostosis interna frontalis is a compensatory mechanism for atrophy of the brain Other observers have stated that the etiology may be related to endocrine or metabolic disturbances.

CLINICAL FINDINGS

Hyperostosis interna frontalis rarely produces any symptoms However in some cases, there have been indications of cortical irritations and headaches and other signs of intracranial disease

ROENTGENOLOGIC FINDINGS

In the lateral views this condition may be confused with calcification of the falx cerebri However, in the anteroposterior projection it is seen that calcification in the falx lies in the midline whereas the hyperostosis lies to each side of the midline and conforms to the convexity of the frontal bone It is also noted in the lateral view that only the inner table of the bone is involved, an aid in differentiating this process from the hyperostosis produced by meningioma. The diploe are usually not affected but occasionally there may be some thinning of the diploe adjacent to the involved inner table Occasionally the outline of the bone proliferation is smooth but more usually it presents a somewhat rippled or irregular appearance (Fig 582)

HISTOPATHOLOGY

Microscopically hyperostosis interna frontalis shows the same appearance as does the spongy or eburnated osteoma

TREATMENT

No treatment seems to be indicated in cases of hyperostosis interna frontalis Surgery is more dangerous than the situation warrants

Hyperostoses

Benign hyperostoses are fairly frequent and are usually of uncertain significance Traumatic *hyperostoses are rare.* The traumatic type of hyperostosis, as the name implies, usually gives a history of previous trauma. These hyperostoses are of little significance They may be confused with osteoma and occasionally hyperostosis produced by meningioma. However the traumatic hyperostoses are usually focal which along with the history of previous injury may lead to easy differentiation on the x ray film

MALIGNANT BONE TUMORS

Endothelioma or Ewing's Tumor

This tumor is very rare as a primary lesion in the skull or jaws. For more complete study,

Fig. 582

the reader is referred to the literature dealing with bone tumors The rarity of endothelioma of the jaw or skull is shown by studies of distribution of Ewing's sarcoma made by J J Morton. In his series of 190 endotheliomas there was only one case each of skull and jaw involvement. In a study by C F Geschickter at the Johns Hopkins Hospital three Ewing's sarcomas were found in the skull Two of these cases were located in the region of the mastoid process and one arose in the frontal bone

PATHOGENESIS

Various investigators have attributed the origin of Ewing's tumor to the endothelial lining of blood vessels or lymphatics or the reticulo-endothelial system Coley states that observers have repeatedly noted cases in which the earliest symptoms and signs suggested an underlying infectious process (fever leukocytosis) Some have wondered whether an obscure infection, such as virus, may not be a factor in the development of the endothelioma. For this reason, the differential diagnosis between osteomyelitis and endothelioma is often difficult According to Ewing the tumor may be either solitary or of multiple origin Therefore, if the diagnosis is suspected in the jaw or skull, all of the skeletal bones should be submitted to x ray examination. According to Geschickter and Copeland, there is a latent period of from one to twelve months between the appearance of the primary tumor and the involvement of other parts of the skeleton.

CLINICAL FINDINGS

Ewing's tumor usually occurring in early life involves males more often than females. The shafts, rather than the ends, of the long bones are more commonly affected The tumor develops slowly without giving symptoms at first Later, pain, intermittent in character, lancinating or cramp-like, develops. Paresthesia of the lips may occur with jaw envolvement As the tumor enlarges, disfigurement results in direct proportion to the size of the tumor There are signs of local inflammation, the affected parts being warmer but without erythema. There are rather marked constitutional symptoms, such as elevation of temperature as high as 103° and 104° F and leukocytosis. There may be accompanying albuminuria. Later on anemia sets in without leukocytosis.

ROENTGENOLOGIC FINDINGS

The roentgen findings are variable Involvement is diffuse and the cortex may be expanded and often split into layers like an onion peel There also may be a sunburst appearance, making it difficult to differentiate from osteogenic sarcoma The onion peel appearance is not commonly present in osteogenic sarcoma. The roentgen examination may easily be confused with chronic sclerosing osteomyelitis Bone destruction and bone proliferation are usually found simultaneously in these lesions. The earliest destructive changes, according to Pancoast Pendergrass, and Schaeffer, may involve the diploe with formation of small radiolucent areas. At times, bone proliferation predominates with increase in the thickness of the inner and outer tables of the skull

HISTOPATHOLOGY

The tumor is very cellular and soft, and at times vascular Histologically the tumor is composed of small, polyhedral cells with small, round or oval nuclei, showing many mitotic figures The nuclei are hyperchromatic and the protoplasm is clear There are no giant cells and no multinucleated cells.

Fig. 582. Hyperostosis interna frontalis in a 20-year-old white female. Complaint—hearing difficulties in right ear No relationship to the x-ray findings was established. Patient did have headaches, accentuated by bending or stooping

A. Lateral view—irregular thickening of inner table.

B. P A view—thickening of inner table to each side of midline Arrow indicates calcification in falx cerebri lying characteristically in midline.

TREATMENT

Endothelioma of the bone is one of the most radiosensitive tumors Sometimes they disappear under small amounts of irradiation, only to recur in a more radioresistant stage A fractional dose technic of irradiation is preferable using two or more ports whenever possible The maximal dose should be delivered in one continuous course rather than to give lesser amounts simply because the tumor seems to respond rapidly Incomplete destruction by irradiation invariably results in recurrence of a more resistant form.

In treating Ewing's tumors of the extremities, some have advocated amputation on the basis that the tumor first begins in one area and other lesions found are metastases and not individual tumors It is hard to conceive that resection of Ewing's tumor in the jaws or skull would be efficacious except where there is a very small area of involvement in a very early case Such a condition would probably only occur in the mandible

The prognosis of Ewing s tumor is not good even when radical treatment consisting of surgery or radiation or both has been carried out

Osteogenic Sarcoma

PATHOGENESIS

Osteogenic sarcoma of the skull is a rare disease. Of the thirteen cases of malignant tumors of the skull reported by Geschickter in 1936, eight were osteogenic sarcoma According to Coley it has been estimated that bone sarcomas occur in about one out of every one hundred thousand individuals in the United States. In one series of 500 cases of bone sarcoma (Geschickter and Copeland) the upper and lower jaws were involved in twenty six cases and the calvarium was involved in only twelve cases. Of these twelve cases one was a fibrosarcoma and three were Ewing s sarcoma.

Of 312 cases reported by Coley including chondrosarcoma, seven of these lesions were in the cranial bones and twenty two in the mandible. Essentially osteogenic sarcoma is a disease of youth but it may occur at any age.

The etiology of osteogenic sarcoma is not known However there is a definite known relationship to Paget s disease Davey and Cook report that about 40 per cent of the cases of osteogenic sarcoma also have Paget s disease. They indicate that Paget s disease is more common in men than in women, and the age at which osteogenic sarcoma occurs in these cases is on the average of about fifty years Byrd reported from Peter Bent Brigham Hospital the incidence of Paget s disease was about one in three thousand. The relationship between the two diseases seems to be definite but the nature of that relationship is not definitely known. The incidence of Paget s disease is highest between the ages of sixty five and seventy According to Davey and Cook, Paget s disease was known to be present about eight years on the average before malignant change appeared and the malignancies usually arise at sites of greatest stress in bones They also show that the skull was third in frequency of site of involvement of monostotic Paget s disease.

The etiology of Paget s disease is unknown. There is no apparent hereditary influence and the disease is evidently not of congenital origin. Inflammatory traumatic, constitutional abnormality and endocrine disturbances have been suggested but none of these have been of proved significance

CLINICAL FINDINGS

The sequence of events in osteogenic sarcoma of the skull is quite different from that seen in such lesions in other locations. Many of the reported cases had no symptoms and were similar in that respect to the case shown in Figure 583 This patient noted the presence of a small non-tender firm nodule in the right parietal region which caused no symptoms It continued to increase in size fairly slowly His physician thinking it an abscess, opened it daily for two weeks and though

there was copious bleeding no pus was found Following this, growth was more rapid, but there were no symptoms attributable to the lesion itself The tumor was resected by the late Dr W E Dandy One year later, the patient returned to the hospital with an unrelated disease from which he died. Autopsy was not obtained, but clinically no evidence of metastasis was present

In Geschickter s report he mentioned that headaches are a common symptom, and that, in general, the duration of the tumor prior to examination is longer in the skull than in other locations. Osteogenic sarcoma is most commonly seen in the occipitoparietal region and in young individuals

It has also been stated that osteogenic sarcomas may be rather soft at times or, if firm then less firm than bone, especially true of the osteolytic sarcomas. Pressure may produce a crackling sensation apparently due to the breaking of the radiating spicules of bone, readily visible on the x ray film.

ROENTGENOLOGIC FINDINGS

Osteogenic sarcoma produces changes in the skull similar to those it produces elsewhere These changes are bone destruction periosteal reaction, and soft tissue changes The bone destruction involves both tables and extends into the diploe Diploic destruction (Fig 583) is manifested by the moth-eaten appearance of the surrounding bone In tangential views, the sunburst or sunray effect may be apparent Periosteal reaction can be noted in adjacent areas as an acute-angled triangle lying against the surface of the bone, with the short side adjacent to the tumor Soft tissue changes are first those of edema (and vascularity) around the tumor Later on, there is actual soft tissue invasion

Osteogenic sarcoma arising in Paget's disease gives evidence of the malignant change by the rapid appearance of a new mass. There may also appear in the roentgenogram an area of irregular complete bone destruction. These lesions may also be osteoblastic and hence will produce both bone destruction and new bone.

HISTOPATHOLOGY

The most constant and characteristic finding in osteogenic sarcomas is the spindle cell, with a small hyperchromatic nucleus and poorly defined cytoplasm. These cells may be small or large They may even be polyhedral in shape Numerous mitoses are seen, and giant cells usually are present. In the telangiectatic type (fast growing), hemorrhage is a regular feature There may be bits of bone and cartilage present in varying stages of differentiation



Fig. 583 Osteogenic sarcoma—33-year-old white male, noted a mass four months previously increasing in size until at time of admission it was 10 x 10 x 4 cm. Roentgenogram—destruction in right parietal bone with diploic involvement as evidenced by the heterogeneous radiolucency surrounding larger area of destruction. There is no evidence of vascular engorgement, as is commonly seen in these tumors.

TREATMENT

No treatment seems to be efficacious. Surgery is perhaps preferable in the skull, but some have recommended intensive radiation therapy within a short period of time, followed later by total excision or amputation (of a limb) However in all of the series reported, death has followed soon from disseminated metastases

Multiple Myeloma

Multiple myeloma is also a rare disease of the skull and when present is usually asso-

ciated with extensive involvement of other portions of the body There are no cases of multiple myeloma in our series of 195 jaw tumors which occurred in the skull to the exclusion of other bones

PATHOGENESIS

The pathogenesis of this disease is still unknown

CLINICAL FINDINGS

Multiple myeloma occurs most commonly in the fifth to seventh decades and between the ages of fifty and sixty By the time multiple myeloma is diagnosed it usually has involved many bones of the skeleton Rarely is there a single lesion Individual tumors vary greatly in size, and generally there is distribution throughout the skeleton, an important diagnostic consideration. There is no typical clinical story However according to a study of forty cases by Batts in 1939 pain was noted in every instance In only three of these forty cases were the lesions solitary The most frequently involved bones were those of the skull with the spine ribs, and pelvis next in order It seems that the sites of predilection are those where there is blood formation in adulthood. In approximately 50 per cent of Batts series of forty cases, there were palpable soft tumors on the skull and body As mentioned, pain although not necessarily marked in the early stages, is the outstanding symptom The pain is rheumatoid in character wandering and intermittent Some patients have neuritic pain aggravated by motion or pressure Systemic symptoms, as pulmonary changes with lymphedema, severe nephritis nonprotein nitrogen retention in the blood and low blood pressure are also present Bence Jones bodies are found in the urine in from 60–70 per cent of the patients. The disease is usually fatal.

ROENTGENOLOGIC FINDINGS

Roentgenographically the lesions in the skull and jaws are sharply circumscribed areas of decreased density varying considerably in size There is no surrounding bone reaction On careful study it can be noted that the lesions are central in location with no widening of the tables of the skull The bone defects are usually not as large but more numerous than in metastatic malignancy Their multiplicity and the rounded shape without bone reaction are the three most characteristic roentgenographic findings Thoma states that the mandible is quite frequently involved by many typical lesions, generally extending into the rami. They usually form large radiolucent areas with irregular outline and osteoporotic margin evidence of infiltration (Fig 584 A and B)

HISTOPATHOLOGY

Grossly the tumor appears translucent or opaque with a whitish-gray or deep red color Microscopically the cells are crowded together without intercellular substance. The tumor is rich in blood vessels, having a single layer of endothelium There may be evidence of hemorrhage and eosinophiles, flat cells and giant cells usually at the outer borders of the tumor The cells themselves are quite uniform round oval or egg-shaped with eccentrically placed nuclei resembling plasma cells. Sometimes two or three nuclei are seen in one cell Histologically about 78 per cent of these lesions are plasmocytomas

TREATMENT

Irradiation commonly relieves pain and other symptoms and may prolong life There is no indication for surgery excepting biopsy In Batts series the average duration of life following diagnosis was two and one half years The prognosis is more favorable in younger individuals and those in whom at the time of diagnosis the lesion is unicentric or localized Arai and Snapper have reported some beneficial palliative results with the use of stilbamidine

Loge and Rundles (1949) recently reported four patients with multiple myeloma who were treated with Urethane Total dosages of 120 to 290 grams were administered over periods of 8 to 10 weeks There was striking symptomatic

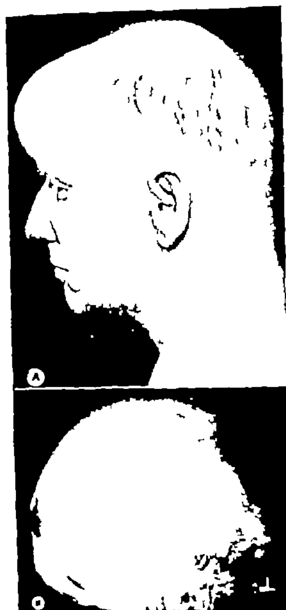


Fig. 584. Plasma cell myeloma—52 year-old white male who 2 years previously received a blow to left forehead. Shortly afterward a jelly like mass appeared, gradually increasing in size and, during the past 6 months, became harder Only complaint a "top-heavy" sensation and mild headaches, relieved by aspirin. There were visibly distended veins around and over the 7 cm. mass of irregular consistency Generally it was firm with areas of greater and lesser hardness. Firmly attached to bone but not to the skin. No Bence Jones protein, moderate anemia. Partially removed at operation followed with roentgen therapy Patient is in good health four years later—no recurrence of tumor

A. Appearance of patient.

B Large multiloculated cystic-appearing area involving the frontal bone suggesting fibrous dysplasia. There is no surrounding bone reaction. Note prominent vascular markings in the skull.

relief relating to all aspects of the disease Blood studies were gradually returned to normal and myeloma cells were quantitatively decreased in the bone marrow Further study is being carried on by Rundles. The immediate results so far observed are quite impressive

GRANULOMATOUS DISEASES

PATHOGENESIS

This group of diseases includes *Nieman-Pick's*, *Gaucher's*, *Letterer-Siwe's diseases eosinophilic granuloma*, and *Hand-Schüller-Christian's disease* The last mentioned is also known as xanthomatosis. Schüller and Christian originally thought that the disease was due to pituitary dysfunction but in 1928 Roland proved it to be due to lipoid metabolic disturbance It is a relatively rare, probably familial constitutional derangement of lipoid metabolism in which there is a deposition of lipoids particularly cholesterol and its esters This takes place in the reticuloendothelial system and results in characteristic hyperplastic reactions

Letterer Siwe's disease, according to Coley, is closely related to Hand Schüller-Christian's disease and eosinophilic granuloma and merely represents various gradations of the same clinical disorder The pathogenesis of the disease, as the others in this group, is unknown.

It is thought by some that eosinophilic granuloma is the result of infection, but attempts to recover the causative organism have been futile

Gaucher's disease is recognized also as being a metabolic disease, resulting from a disturbed kerasin (cerebroside lipid) metabolism which, like cholesterol, is deposited in the reticuloendothelial system.

Nieman Pick's disease is also a familial constitutional disease which similarly to Gaucher's disease has a predilection for the Jewish race. The metabolic disturbance in this disease involves the phosphatid lipids

CLINICAL FINDINGS

The Hand-Schüller-Christian syndrome is characterized by defects of bones exophthalmos, and diabetes insipidus. It occurs more commonly in males than in females and especially in infancy or early childhood There is generally a prior history of good health and

the onset of the disease itself may date from an acute inflammatory process which is followed by irritability and later exophthalmos. Additionally there may be pain in various parts of the body sore mouth loose teeth and xanthomatous spots on the skin There may be bouts of fever mistaken for infection or rheumatic fever, and there may be retardation of growth without weight loss. Anemia is common.



Fig 585 Hand Schuller—Christian disease
A year-old white female who 7 weeks previously noticed a small protrusion over the lateral aspect of the right eyebrow There was no change in appearance nor did symptoms develop until 5 weeks later when the right eye became closed by edema, which disappeared spontaneously Biopsy Hand Schuller-Christian s disease There is a solitary osteolytic lesion in the right frontal bone No surrounding bone reaction and no other lesions.

Letterer Siwe s disease is a rapidly fatal disease of infancy seldom occurring after two years of age There is a generalized rash purpura severe anemia and fever

Eosinophilic granuloma is most often seen in children and adolescence Symptomatology is variable The onset is often gradual with complaint of long standing Swelling or deformity of the affected part may be present varying according to the site and degree of involvement and there may be pain and tenderness. Mild to moderate leukocytosis with eosinophilia is common

Gaucher s disease is characterized by splenomegaly and lymphadenopathy usually appearing early in the course of the disease as a result of lipoid infiltration into these organs. At times bony structures are involved The course is long and chronic with periods of remission It is more common in females

Nieman Pick s disease is invariably fatal, with few infants surviving beyond the second year There is marked anemia and a decided leukocytosis in contrast to the leukopenia of Gaucher s disease Blood studies usually reveal high lecithin and cholesterin-fatty acid.

ROENTGENOLOGIC FINDINGS

In Hand-Schüller-Christian s disease roentgen examination usually reveals diffuse or splotchy destruction of the osseous portions of the body Changes seen in the skull are particularly of interest and importance The inner table of the calvarium usually is eroded early The process later extends and erodes the outer table Bone thickening is rare but does occur particularly in adults

In some patients soft tumor masses may be noted over the cranium and in these cases the outer table is first involved The eroded areas are distinct and sharp, though the edges may be irregular There is no surrounding bone reaction (Fig 585 and 586 A and B)

Letterer Siwe s disease produces changes in osseous structures which are similar to those of Hand Schüller-Christian s disease.

Eosinophilic granulomas cause a purely lytic change in bone and appear very much as a single lesion of Hand Schüller-Christian s disease namely they tend to be circular or oval in shape with somewhat irregular borders and no surrounding bone reaction (Fig 587) They are of central origin in contrast to the osteoid osteoma which is cortical in origin and generally produces surrounding sclerosis of bone

In Gaucher s disease osseous structures may at times be invaded, causing sufficient decalcification to become evident on the roentgenogram Usually there is only a generalized osteoporosis appearing as small or larger areas of destruction of the spongiosa Expansion of the cortex and widening of the distal ends of the

long bones, particularly the femora giving the so-called *over modeling* effect is characteristic Body weight may compress the affected bones. Periosteal reaction and cartilagenous damage are absent The skull is rarely affected



Fig 586 Hand-Schüller-Christian syndrome. Two-year-old white female, with 18 months' history of skin eruption, sore mouth and "loose teeth" since beginning of dentition. Symptoms of diabetes insipidus all her life (at present consuming about 6 quarts of liquid a day) Previously treated for 6 months for "seborrheic dermatitis."

(A) Solitary lytic lesion in parietal area.
(B) Multiple lytic lesions in the mandible.

Nieman Pick's disease produces changes similar to those seen in Hand-Schüller-Christian's disease

HISTOPATHOLOGY

The diagnostic feature in Hand-Schüller Christian's disease is the typical foam cell. These cells are widely scattered or in clumps and imbedded in a granulomatous base

Letterer Siwe's disease is characterized histologically by marked proliferation of the cells of the reticuloendothelial system, especially in spleen lymph nodes, and skin.

The eosinophilic granuloma typically consists of histiocytes interspersed with eosinophiles

Gaucher's disease shows the presence of large cells in the spleen, lymph nodes, and bone marrow, which contain kerasin

Nieman Pick's syndrome results from faulty cellular metabolism of syringomyelin and represents a histiocytosis. All organs are affected.



Fig 587 Eosinophilic granuloma—thirty five year old white male has had trouble with his teeth for 9 years. Gums began to swell and were sore in 1940 There was a great deal of pain and receding of the gums. Because of pain, all teeth were extracted in 1944. Tissue removed at this time showed eosinophilic granuloma. Since then has had continued soreness and superficial ulceration on the lower right alveolar process. X-ray shows an irregular patchy destruction of the anterior two-thirds of the mandible which is purely lytic. There are no trabeculae, septae, or surrounding bony reaction

TREATMENT

The treatment of Hand-Schüller-Christian's disease is essentially radiologic Usually the response to relatively small doses of radiation is prompt and satisfactory, often followed by remarkable restoration of normal bony contours Factors which may be used are 200 KV 15 MA, ½ mm Cu + 1 mm. Al filter 50 cm. T.S.D and ports of sufficient size to adequately cover the lesion Total doses of 300 r–500 r are generally sufficient

The consensus of opinion seems to be that surgical management of eosinophilic granuloma is the treatment of choice However it is our feeling that radiation therapy has much to offer especially in areas difficult to approach.

Here again, small to moderate doses of radiation suffice.

No effective treatment is known for Nieman-Pick's disease or for Letterer Siwe's disease.

Splenectomy in Gaucher's disease has caused symptomatic improvement and has retarded progression of the disease but the process continues elsewhere.

METASTATIC TUMORS

The skull may be, and often is, involved by metastases or presents manifestation of generalized diseases.



Fig. 588 Metastatic neuroblastoma. A 3½ year-old white female whose first symptom was pain in the back. Later firm masses appeared on the skull. Biopsy showed neuroblastoma. (Autopsy) Roentgenogram shows multiple irregular-sized osteolytic areas due to metastases. The white spot is an artifact.

Metastatic lesions are common and, as previously mentioned, are most often due to breast and prostate malignancies. Radiographically these lesions are characterized by their multiplicity and varying size (Fig 588 and Fig 589 A B and C) By x ray alone it is difficult or impossible to name the primary site. Prostatic lesions usually are osteoblastic and can be distinguished from Paget's disease in that they are predominantly destructive and not deforming. Well marked indications of a primary lesion elsewhere are usually found by careful history physical examination and x ray studies. Metastatic breast lesions are commonly osteolytic though the slowly progressing lesions may be osteoblastic. There is no surrounding bone reaction. They can be diagnosed only by history and their multiplicity. When solitary it may be impossible to determine whether it is primary or secondary.

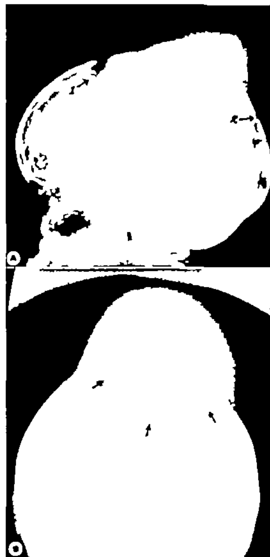


Fig 589 Metastatic lymphoblastoma—7 year-old white female 3 years before exploration of abdominal mass revealed reticulum cell lymphoblastoma. Following a trivial head injury 5 months prior to these films a mass appeared which grew rapidly. Both a thrill and bruit were present.

(A) The large mass is visible. Note the radiating spicules of bone (similar to those seen in osteogenic sarcoma). Both tables which appear expanded are involved. The arrows indicate widening of the suture lines as a result of increased intracranial pressure.

(B) The A P projection showing the bone destruction (arrows) and radiating spicules.

The skull may be involved by lesions of the adjacent soft parts as meningioma (Figs 590 A, B and 591 592 A and B) lymphoepithelioma (Fig 593 A and B) carcinoma of the scalp (Figs. 594 and 595 A and B) fibrosar

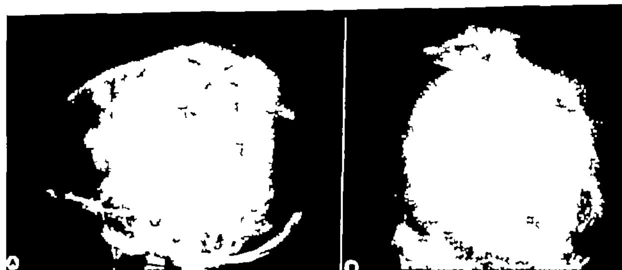


Fig 590 An unusual manifestation of secondary involvement of the skull by a meningioma. This was mistaken elsewhere for fibrocystic disease and treated with x-rays. The tables are expanded thinned and partially destroyed. Though most of the lesion appears cystic, the radiating spicules can be seen along portions of both tables.
A. Lateral view
B A P view

coma and so forth The meningioma was described in conjunction with osteoma The other lesions are generally osteolytic in appearance In these cases diagnosis should be evident from



Fig. 591 Meningioma producing a large mass in the frontal region Roentgenogram demonstrates the typical spiculation seen in meningiomas.

examination of the patient with the x ray being used as a guide to the extent of involvement

Chordomas are rare malignant lesions occurring at either end of the spinal axis and arising from embryonic remnants of the noto-





Fig. 592

Fig 592
A. Septomeningeal sarcoma involving the skull. Complaint of left-sided weakness and a mass on the right parietal region of one year's duration. The mass was soft without fluctuation.
B Osteolytic involvement in the parietal area. Note the marked and unusual vascular pattern.



Fig 593 Lympho-epithelioma. A 45-year-old male who had noticed a painless, soft lesion 5 months previously in the region of the right hard palate. This was treated elsewhere by cautery excision and an unknown amount of x ray. There was extraocular paralysis and 5th and 8th cranial nerve involvement on the right.

A Showing destruction of (1) pterygoid processes, (2) vomer and (3) medial portion of the petrosa on the right side. Left side is normal.

B The floor of the right antrum (1) has been invaded and the hard palate and alveolar portion of the maxilla are destroyed (2) note the membrane thickening in the right antrum



Fig 594 Involvement of the skull secondary to squamous cell carcinoma of the scalp in a 56-year-old white female. Destruction of the outer table is indicated by arrow (1) and involvement of the inner table by arrow (2). There was no bone infection. The reaction is purely lytic.

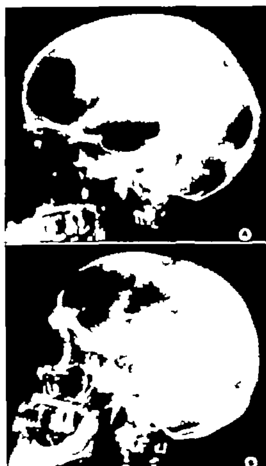


Fig 595 Squamous cell carcinoma of calvarium. 41 year-old white female. Nine months prior to first visit patient noticed a breaking out on the right side

Fig. 595 (cont.)

of her head which she "picked." Following this, a sore developed. On admission large open wound which on biopsy showed squamous cell carcinoma. The patient was treated with multiple ports of x-ray receiving a total of 6162 r (air) in a period of 2 months.

A Initial examination revealing invasion of the calvarium. There is mixed osteolytic and osteoblastic activity.

B Examination over 6 years later showing osteomyelitis of the skull. There was no evidence of active malignancy but there was a draining sinus present due to the chronic osteomyelitis. Note the irregular patchy destruction surrounded by marked bone reaction



Fig 596

A. Paget's disease. A 74-year-old colored male. Complained of failing vision of 2 years duration. Also had deafness of 2 years duration and occasional tinnitus. Patient had not, himself noticed it, but his head appeared larger than normal Roentgenogram demonstrates typical changes of Paget s disease. The tables are expanded and thinned, with numerous areas of fluffy-appearing increased density The facial bones are also involved Note the platybasia (basilar impression) which is often seen in this disease.

nant and are prone to recur They produce bone erosion which is not characteristic. Only by its location can the true diagnosis be suspected on the x ray

Cholesteatomas (epidermoidomas) apparently arise from embryonic rests of epithelial cells during fetal development and may be of two types The dermal type contains epithelium and hair and the epidermal type contains a transitional squamous cell lining They are most common in the temporal regions. Usually cholesteatomas produce irregular wavy bone destruction

Paget's disease was largely discussed in connection with osteogenic sarcoma so it will be only briefly mentioned here According to Sosman, there are two phases of Paget's disease, the monophasic and biphasic types In the first there are localized areas of osteoporosis in

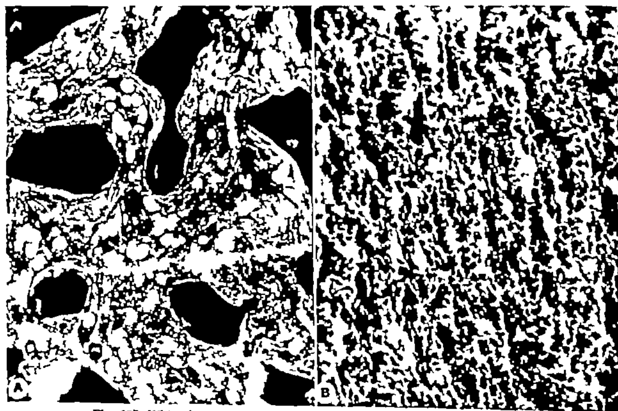


Fig. 597 White female, aged 68—Paget s disease of several years' duration

A. Photomicrograph showing histological picture of Paget s disease

B Photomicrograph showing osteogenic sarcoma which developed in left frontal bone (Patient of G E. W — reported by Manganiello, Reimann and Wagner 1948.)

chord (Chapt. II) Most commonly they occur in the spheno-occipital region or the sacrococcygeal area These lesions are locally malig

several bones The second phase is the stage in which both porosis and increased density are seen side by side. Indeed, it is thought by

many that so-called *osteoporosis circumscripta* is an early stage of Paget s disease

The onset is insidious with pain usually in the lower extremities and sometimes headache Involvement is often fairly symmetrical though this is not always so There follow bony deformities which may produce an ape-like appearance The head enlarges.

In the x ray film the tables of the skull are widened and thinned and sandwiched between are fluffy areas of increased density The outer table is frequently first involved with the inner table remaining clear in outline usually until very late in the disease In advanced cases, platybasia or basalar impression develops, which may produce symptoms (Fig 596 and 597 A and B)

The pain of Paget s disease as well as the headaches, is usually easily controlled with moderate doses of x ray Some of our cases complaining of headache have been completely relieved by small doses to the cranium Likewise pain elsewhere is relieved Factors are 200 KV 2 mm Cu + 1 mm Al filter 50 cm T.S D., and one port to each side of the head sufficiently large to cover the cranium. Doses of 150 r (air) are given to a total of 300 r by alternating ports daily

The skull may be affected by sickle cell anemia, Cooley s anemia etc. but the changes are usually sufficiently characteristic so as not to cause confusion. The changes are diffuse. The tables are widened and between them there are perpendicular parallel striations

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Chapter XXI

REHABILITATION

1 RECONSTRUCTIVE SURGERY OF SOFT TISSUES

by EDWARD M HANRAHAN M D

The decision regarding immediate or deferred reconstruction is part of the larger problem in the treatment of head and neck tumors. In general after apparently complete removal of primary growths, any repair more elaborate than primary closure, perhaps with sliding adjacent flaps or the application of a skin graft should be deferred until after an observation period of at least six months During that period flaps may be elevated and extended while the patient loses very little time from his usual occupation If a satisfactory temporary prosthesis is made, the observation period may be lengthened with greater assurance that the later reconstruction will not be jeopardized by a covered local recurrence.

The size and position of the defect following removal of a surface neoplasm will determine the best means for closure When the lesion is removed by elliptical excision, it is important that the direction of the ellipse be properly placed in accordance with the tension lines in the skin (Fig 598) Langer s description (1861) of these lines has been accepted as accurate and diagrams based on his work have been reproduced many times. This subject has recently been reopened by Rubin (1948) and by Kraissl and Conway (1949) whose conclusions regarding the explanation of these lines, their direction and variability is more in accord with clinical experience

The nearer the lesion is to unfixed parts such as the eyelids and mouth the more important it is to avoid distortion resulting in ectropion or a scarred lip

Surface defects of the face should be closed by local flaps if possible Although such flaps may at times seem large and the necessary incision extensive they are preferred to skin grafts especially when taken from below the clavicles In general it is easier to slide lateral flaps medialward than the reverse and skin from the neck may be migrated considerable distance upward onto the face

When local tissue cannot be utilized a skin graft is called for The skin of the face and neck has a color and texture differing from that of the remaining body skin It contains much more red which is apparent both in winter and summer Full thickness grafts are preferable to split grafts. Although the take of the former is less certain their ultimate appearance as to texture color and pliability is usually better than split grafts. Results with the latter vary depending on their thickness The thinner grafts tend to remain shiny to undergo changes in pigmentation and to develop less subcutaneous fat than the thicker variety Full thickness grafts placed on the face should be taken from behind the ears or from the supraclavicular regions as skin from these areas closely resembles the skin of the face The donor sites may be closed by suture or in the case of large grafts by split skin grafts from elsewhere

FLAPS

In planning the migration of a flap to the head and neck the principle of delay in the preparation of the flap is utilized Variation in the methods used are frequent Possibly the simplest procedure is the elevation of a bipedicled tube flap with closure by suture of the donor defect the tube itself furnishing all of the flap to be utilized (Fig 599) When

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there exists the slightest doubt about the closure by suture, a split skin graft is used to cover the defect.

There is frequently some loss of tubed skin by shrinkage which may be allowed for in planning the size of the tube. The tube may be used only as a carrier of an extension which is re-sutured back in its bed under normal tension during the period of delay This is

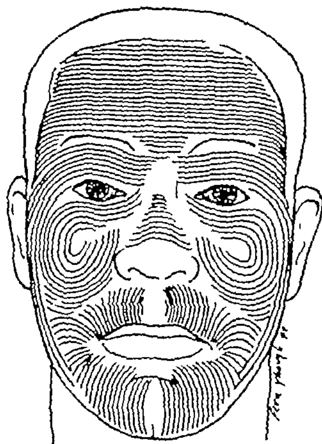


Fig. 598. Tension lines of the face redrawn from Rubin. These lines and the wrinkle lines described by Kraissl and Conway are a more accurate basis for planning the direction of incisions than the lines described by Langer

customary when the extension is to be lined by a graft or when the lining is made by a folded portion (Fig 600)

The determination of the safe period for final division of a flap or for its extension may sometimes be uncertain In the case of a tube whose one end can be wholly occluded the problem scarcely exists. An extension however may present difficulties in that the tentative obstruction of circulation may not be complete This may interfere with the conclusion to be drawn from such examinations as with the observation of the penetration into the flap of fluorescein when viewed by a Woods filtered quartz light, or by comparing the absorption time of an intradermal wheal of normal saline in the flap with the absorption rate in normal skin In general, one more delay than actually necessary is better than one less, and an additional few days between stages is better than too few

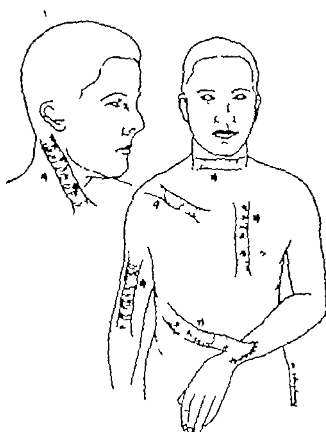


Fig 599 Tubed flaps commonly used in face reconstructions. A, B C, and D are usually suitable on the lower face, C and D being particularly suitable for extensions of the free end

THE SCALP

Defects of the scalp which do not include the pericranium may be closed by split skin grafts Some defects in such conspicuous places as the forehead line may be closed by rotated neighboring flaps and that donor site closed by grafting If the defect includes the pericranium, the bare bone may be covered immediately by a rotated flap which leaves pericranium in its donor site to be covered by a split graft It is best whenever possible to avoid leaving bare bone to be treated by the method of inducing

granulation tissue growth through multiple outer table perforations and subsequent grafting

THE SCALP AND SKULL

A clean removal of scalp and skull may be closed by bone cartilage strips and either

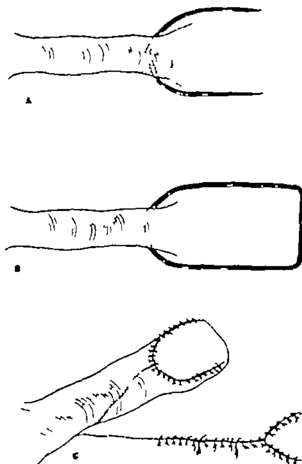


Fig 600 A method of extending and lining a tubed flap redrawn from Schuchardt
A. The extension incised and undermined at the first delay
B The end divided two or three weeks later and delayed
C The lined flap ready for use

single or double pedicled scalp flaps (Fig 601) Such scalp flaps are elevated above the pericranium which is in turn grafted with split skin Exposed dura should always be covered by a flap as it is not only unreliable as a source of granulation tissue but also if the bone defect is not repaired at the time subsequent reconstruction with bone cartilage or tantalum plate is made much more difficult Tantalum plate may be shaped to the proper form for secondary reconstruction

Skull defects following removal of infected ulcerated new growths or exposed areas of irradiation osteonecrosis call for single or double pedicle flap closure and secondary reconstruction is deferred for at least a year

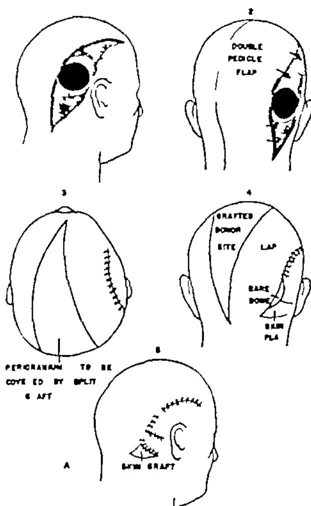


Fig 601A (See Fig. 601A next page)

THE FOREHEAD

Lesions in the median portion of the forehead, often up to three or four centimeters in width are excised and the defect closed by advancing lateral flaps mobilized by incisions placed near the eyebrows or the hairline or both (Fig 602) Larger defects call for full thickness or more frequently thick split skin grafts. Suitable non-hair-bearing skin may be found in the inframammary regions of other

wise very hairy men Grafts applied to the pericranium appear sunken at first but within a few weeks are level with the surrounding skin



Fig. 601A

A, B C, D This illustrates the use of a double pedicled scalp flap to cover a large defect of the scalp and skull following removal of recurrent basal cell epithelioma complicated by osteonecrosis. The x-ray taken after operation shows the wide area of bone removed. The exposed dura was immediately covered by the flap and the donor site split skin grafted In this case a small failure of union low in the occipital region which left bone uncovered called for a second small flap before healing was complete. (See Fig 601 p 780)

Bare bone should be covered by one or more flaps elevated above the pericranium the donor sites being closed by grafting In some cases a scalp flap can be used This necessarily brings hair bearing skin out of place In some women who can arrange the hair appropriately the result needs no further reconstruction In others after several months the flap may be carefully re-elevated leaving connective tissue on the bone which is then split skin grafted. The flap is returned to its original site (Fig 603 A and B)

THE NOSE

Partial surface losses are repaired by post aural full thickness grafts. Complete surface losses such as those following removal of irradiation damaged skin with its resulting distortion and thinning of the alar skin are better treated by a forehead flap Small defects of the alar border are repaired by composite skin and cartilage grafts from the free border of the ear (Koenig 1914 Brown et al 1946) or composite ear lobe grafts (Dupertuis 1946) *Larger full thickness losses of the nose are* commonly repaired by lined forehead flaps The alar border is reconstructed more satisfactorily by the folded distal end of a medial pedicled flap than by a flap pedicled on the temporal vessels unless the latter be the sickle shaped variety Both of these flaps should be delayed before moving (Fig 604)

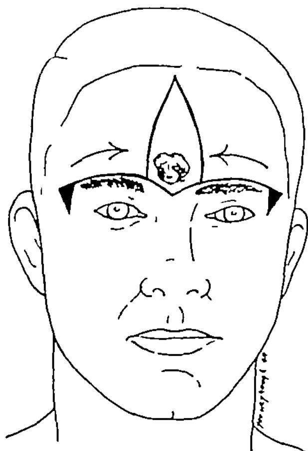


Fig 602 Large defects of the forehead may be covered by migrating local forehead flaps Whenever possible these flaps are preferable to graft

Unless there is reasonable assurance that a malignant tumor has been entirely removed and that recurrence is unlikely reconstruction of a nose should not be undertaken for at least a year During that waiting period a prosthesis will allow the patient to resume his normal activities There are few things which induce greater regret for bad surgical judgment than to have a recurrence call for the destruction of a too early reconstruction

One ala or ala and columella may permit a fairly symmetrical reconstruction of the nose More extensive loss requires total nose reconstruction even though it means ablation of a normal remaining ala For partial losses the sickle-shaped forehead flap of New (1946) permits utilization of forehead skin with less visible scarring (Fig 605 A-C)

The nose lining is made by adjacent skin flaps (after delay) or by skin grafting of the forehead flap at the first delay, combined with infolding of the free border to reconstruct alar borders and columella (Fig 606 A C)

Median frontal pedicled forehead flaps up to 2.5 cm in width may safely be turned down without delay and the defect closed without grafting by freeing laterally with relaxation incisions above the eyebrows (Kazanjian 1946)

Some foreheads do not have enough skin to build a nose and some patients prefer to avoid the forehead skin graft Other flaps sometimes used in nose reconstruction are upper arm flaps or acromio-pectoral flaps (Gillies 1939) These are less satisfactory as to skin color and texture and because of the necessity for preliminary thinning of all possible fat require several delays before use With the acromio-pectoral flap the lateral carrying portion is first tubed and its median extension delayed and thinned in subsequent stages Upper arm flaps are applied high on the nose preferably on the raw surface formed by turning in adjacent previously elevated local skin for lining It is important that in its separation from the arm an abundance of skin be planned for and obtained for the turn in which forms the alae and columella An alarming color change when

this turn-in is made, necessitates that the procedure be abandoned until the developing circulation is adequate for its survival

flap becomes the posterior surface. The defect remaining on the skull is then covered by a split graft.

Fig. 603 This forehead defect resulted from irradiation of a hemangioma in infancy In addition to the atrophic skin there was underlying bone deficiency It was treated by first excising the atrophic skin and closing the defect with local flaps. Six months later diced autogenous cartilage was used to restore contour

THE EAR

Small skin defects of either the anterior or posterior surface are easily repaired by split skin grafts applied to the perichondrium. Lesions on the anterior surface are more apt to call for removal of underlying cartilage when the graft is applied to the exposed undersurface of the posterior skin

Border losses up to two centimeters or slightly larger may be sutured by extending the triangular excision sufficiently into the concha as to greatly weaken the spring of the cartilage

Larger losses of the pinna may need a mastoid skin flap This flap of appropriate shape and size is elevated so that when the ear is brought back to it, it becomes the anterior surface of the ear After later division of the pedicle the remaining portion of the

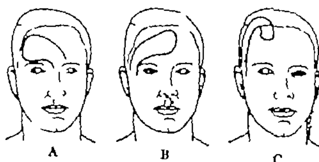


Fig 604

A. Frontal pedicled forehead flap which is preferred if the distance between the hairline and eyebrow permits.

B The temporal pedicled flap is more useful for partial losses and when a low hairline limits lateral forehead skin.

C. The sickle shaped flap leaves less scar on the forehead as the pedicle is placed within the hairline.

Loss of the helical border is repaired by the application of a small neck skin tube After division of the second pedicle, the re

sary to have an acrylic mould which is inserted into the mouth to hold the contour during the healing period

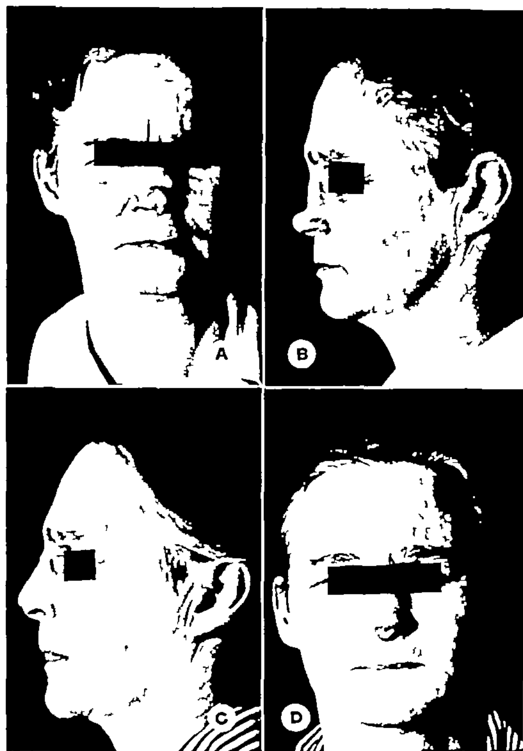


Fig. 615

A and B Saddle nose resulting from the removal of the septum
C and D Nose corrected by the insertion of a cartilage graft secured from the rib.

Corrections of defects in other bones of the face are primarily concerned with improving the appearance of the patient

Destruction of the frontal bones is repaired by the use of iliac bone shaped to fill out the defect

It is important that the frontal sinus is completely denuded of any mucous membrane or if it is desirable to preserve the sinus then

it must be covered with a skin graft before the defect is filled out (Fig 614) The mucous membrane will continue to secrete and an infection will occur with loss of the graft if it comes into contact with it. Filling the defect with bone chips or ground cartilage is not as desirable as a single piece of bone. The chips of bone or bits of cartilage will gradually shrink as the fibrous tissue between the chips contracts. This will result in an uneven contour

Nasal bones and component parts of the nose are not replaced if the nose has been removed. The nose is reconstructed with flaps and cartilage or bone grafts are placed into the soft parts to give the nose shape (Fig 615)

Deformities of the maxillas are corrected by inserting bone or cartilage grafts into the soft parts to re-establish the contours. The antrum must be closed with a graft to permit it to function and the graft is then placed in the overlying tissue Grafts of fat and fascia or corium grafts of skin are not as satisfactory, since they do not give rigidity to the area which is necessary to maintain the contour

Removal of the hard palate presents a problem which is solved by the use of flaps. No attempt is made to insert bone since the palate made with soft parts will permit the use of a denture

The best bone to use for reconstruction of deformities of the face is that secured from the crest of the ilium However, if this is not sufficient, then the next best source is the ribs. Metal and plastic materials have not proven satisfactory These are foreign bodies which are very prone to traumatize the surrounding tissue which then easily becomes infected Often there is a reaction to plastic materials which causes some serum about the appliance followed by infection and the expulsion of the appliance Up to the present time a satisfactory plastic material for burial in the tissues has not been developed.

3 PROSTHETIC RECONSTRUCTION OF MOUTH AND FACE

by James E. Pyott D.D.S., F.A.C.D

The use of a prosthesis is of utmost importance in the successful care of many patients who have had oral and facial cancer removed or destroyed Patients who have suffered cosmetic disabilities must be returned to society as nearly normal as possible i.e. their jaws or remaining parts of bone must be retained in a position close to physiological function by aid of a prosthetic appliance, if necessary Each case presents a problem of its own During the routine care of these cases, the following basic rules must be followed to produce satisfactory results.

1 The ends of mandibular fragments should be held apart mechanically the same distance and as near to the normal position as when the muscles retained the entire jaw before surgery

2 Normal occlusal relation of the remaining teeth must be maintained by adding artificial teeth if necessary, to the appliance

3 In cases involving the upper jaw when bone and soft tissue are surgically removed obturators stints, and Gunning splints are made for protection of new tissue grafts and open areas while healing These appliances also keep food and liquids from passing through the nasal orifice and permit the adequate consumption of food during convalescence

4 Finally a finished prosthesis permanently maintains the normal facial contours and the normal function of the jaws. Sometimes these appliances may include buccal guide planes, retainers, obturators, sections replacing lost parts, and lost teeth

It is essential that a definite routine be followed in all cases, with cooperation between diagnosticians surgeons, radiologists and prosthodontists.

1 Upon admission to the hospital impressions of the maxillary and mandibular ridges, the surrounding tissues, and remaining natural teeth are taken with any good impression ma-

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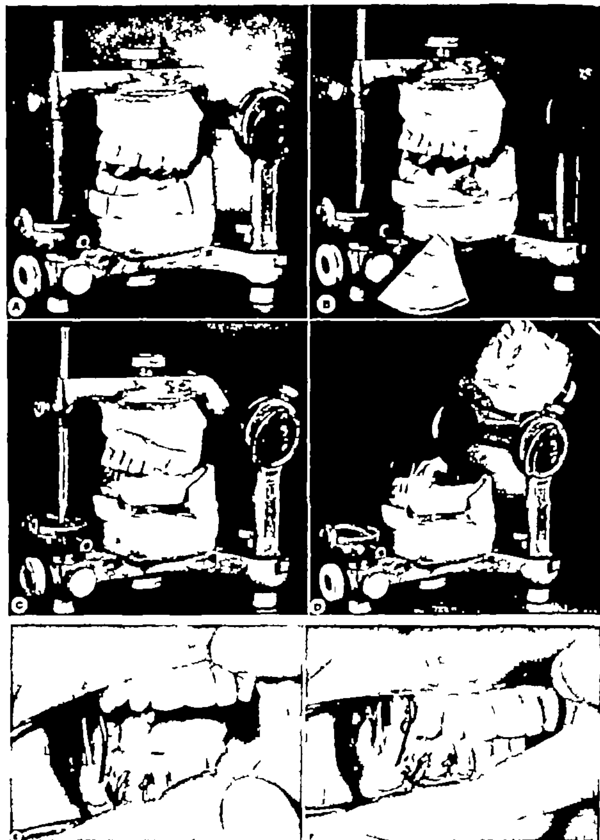


Fig 616 Master models articulated

A Area corresponding to surgical resection outlined on lower model.

B Outlined section removed from lower master cast with plaster saw

C. Prosthesis completed replaced on master cast and ready for insertion in mouth The patient for whom prosthesis was prepared had left mandible resected during composite operation The acrylic portion floated against soft tissues of cheek which had been previously grafted

D Completed prosthesis showing buccal guide arm with Roache clasp attachments and artificial teeth Mandibular fragments held in normal position by acrylic portion abutting stump of ascending ramus

E. Prosthesis in place mouth open Guide arm on right maintaining right mandibular fragment in normal position and allowing vertical motion

F Same as "E." Jaws closed

terial such as hydro-colloids, alginates or plaster, master casts are poured in artificial stone and mounted with correct centric relation on an articulator

2 When external surgery is contemplated a face mask is made in each case, using alginate hydro-colloid impression material or plaster Casts are made of artificial stone.

3 Complete cooperation and understanding are essential between the surgeon and the prosthodontist as to the course of therapy employed. From the master cast the extent of the operation is outlined to approximate before such as methyl methacrylate, vinyl chloracetate polyethelenes, stainless steel gold, and tantilum

Usually the appliance is inserted and adjusted in the patient s mouth at the time of operation. This gives the best results, as it is during the first few days following operation that muscle pull is strongest and will disarrange the position of bone fragments and tissues. When it is impossible to insert the appliance at operation retention of bone fragments is accomplished by a stainless steel bar and sheath (Fig 617), constructed to fit

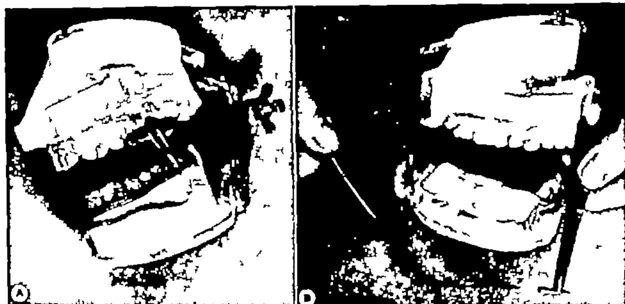


Fig 617

A. Guide plane held to lower teeth with Roache clasps and lingual and labial bars.
B Model of same patient. Sheath and bar attachment shown were inserted into mandibular stumps during operation but had to be removed after two weeks on account of pain. The guide plane (A) was substituted.

dimensions the prosthodontist removes, with a plaster saw the area to be excised at operation (Fig. 616 A–F) This should be cut out so that it can be replaced on the master cast at any time for duplication or for any purpose of checking the original form and relations of the jaws Duplicated casts are made for use in the laboratory The prosthesis is designed and constructed. Since there are so many different types of replacements illustrations, rather than a lengthy description as to material fabrication and laboratory procedure, give a clearer idea of methods and products. Today, materials are available for these appliances as never between the bone ends, and wiring the remaining natural upper and lower teeth into their normal occlusion during operation This maintains the proper relation of jaws or bone ends to one another (See Section 4 of this Chapter)

A résumé of the complete laboratory technic required in constructing all varieties of appliances for face and oral rehabilitation would take more space than can be allotted here Standard technic is employed in surveying cases, waxing up investing burning out casting polishing setting up planes and setting up artificial teeth.

Technic of Constructing a Guide Plane

Care must be taken in designing the guide plane so that the inclined arm is not high enough to impinge on the mucosa of the mucobuccal fold causing trauma and pain

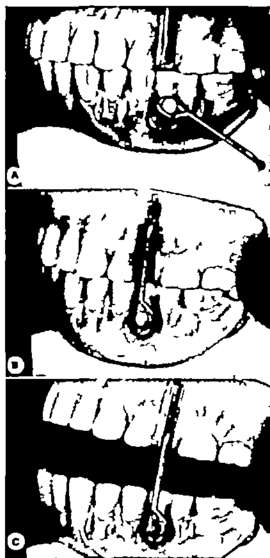


Fig. 618

A. Ball and socket type guide plane on both sides of dentures. Left side shown. Arm out of socket. Edentulous mouth. Note vertical trough in upper jaw bar for guide arm to move vertically

B. Guide arm in trough in closed position.

C. Guide arm in socket at lower end of trough when jaw is in open position. This socket permits a limited amount of lateral and protrusive motion of mandible

The appliance should be comfortable in the patient's mouth and easy to keep clean. Some guide planes are fixed, some removable and others have attachments for elastic band traction

Impressions are taken of the mandibular and maxillary ridges which include all remaining natural teeth. Stone casts are poured and used for master casts, both for study and making duplicated casts on which to do the



Fig. 619

A. Guide plane on partial denture (stone cast). Arm out of guide socket and trough

B. Guide plane in mouth—open position. This guide plane is on side opposite ball and trough arm

C. Mouth closed

laboratory work. A central bearing point is established by the use of the Gothic arch tracer if possible; if not available, a good bite is taken. The casts are then mounted in centric on an articulator

After a study with the surgeon and roent

genologist, the prosthodontist marks the model where the bone is to be resected (Fig 616 A) This section is then removed in its entirety investment in order to cast the appliance. The upper cast is also removed and duplicated in stone These casts are now mounted in

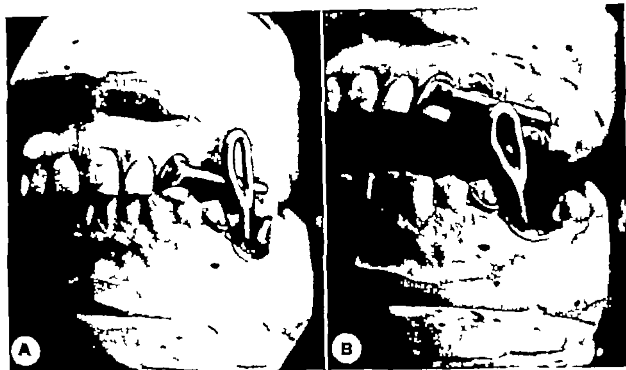


Fig 620 Horizontal bar on upper teeth bridging gap left by previous loss of tooth
A. Articulator closed. B Articulator opened.



Fig 621
A Guide plane—jaws closed. *B* Guide plane—jaws opened.

with a small saw so that it can be replaced on the master cast if necessary (Fig 616 B)

The resected stone cast is removed from the articulator and duplicated in high heat correct centric. The case is surveyed and waxed for casting of clasps, retainers, and buccal guide plane in one piece. After casting it is adjusted and fitted to the master model and

polished Wax is moulded over the resected area to bone depth and as far back as the ascending ramus to support and hold it back in position while healing Teeth are sometimes



Fig 622

A. Appliance with guide plane buccal and lingual bars and artificial teeth
B Jaws opened
C Jaws closed

placed in the anterior region but acrylic only in occlusion with the upper remaining teeth is built in the posterior region This acrylic is cured on another duplicated stone cast After trimming and polishing the appliance is adjusted to the master cast and is then ready for insertion in the mouth (Fig 616 C and D) at the time of operation The appliance is left in position from six to eight weeks before



Fig 623

A. Myxofibroma of right mandible—before operation
B Controlled fixed guide plane cemented to natural teeth Mouth opened Guide arm slides vertically between two horizontal bars cemented to upper teeth which controls motion
C Jaws closed.

removal After the initial edema has subsided and the healing well started the patient is taken off liquid diet and given soft food which he can masticate with vertical strokes.

Later as he learns to use his tongue and manage boluses of food he can eat a regular

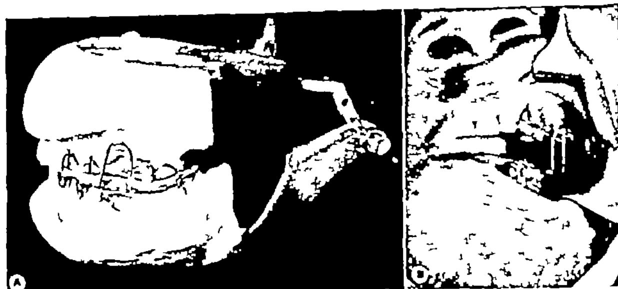


Fig 624

A. Fixed guide plane on cast, showing attachments for rubber band traction
B Appliance cemented to teeth prior to operation of resection of right mandible for fibrosarcoma.

diet with the appliance in position He is taught to remove, cleanse, and replace it as he would a regular partial denture. Later if the resected bone is to be replaced by a section of rib or ilium the base of the appliance is cut away to allow room for the inserted bone. The appliance, so modified is used to maintain the normal position of the jaws while the implanted bone is healing If the implantation has been successful the buccal guide arm is removed from the appliance after six or eight weeks artificial teeth are inserted where necessary and the patient wears the appliance as a partial lower denture and is able to use vertical strokes lateral and protrusive movements of the mandible as before operation (Fig 616 E and F)

In order to keep the guide arm free from impingement on mucosa of the upper mucobuccal sulcus, it may be necessary to put a guide casting on the upper remaining teeth (Fig 620A B) This casting has an arm extending from band to band along the upper teeth for the lower buccal guide arm to pass over when the jaw is in motion. It is cemented on the natural upper teeth before operation



Fig 625

A Obturator on upper partial denture. Patient had upper alveolar resection for tumor
B Appliance in mouth closing maxillary cavity

List of Various Types of Prostheses

Guide planes (inclined planes) (buccal guide planes)

1 Ball, groove and socket type (all removable) (Figs. 618 619 620 621 622)
   A On full dentures (edentulous mouth)
   B On partial dentures

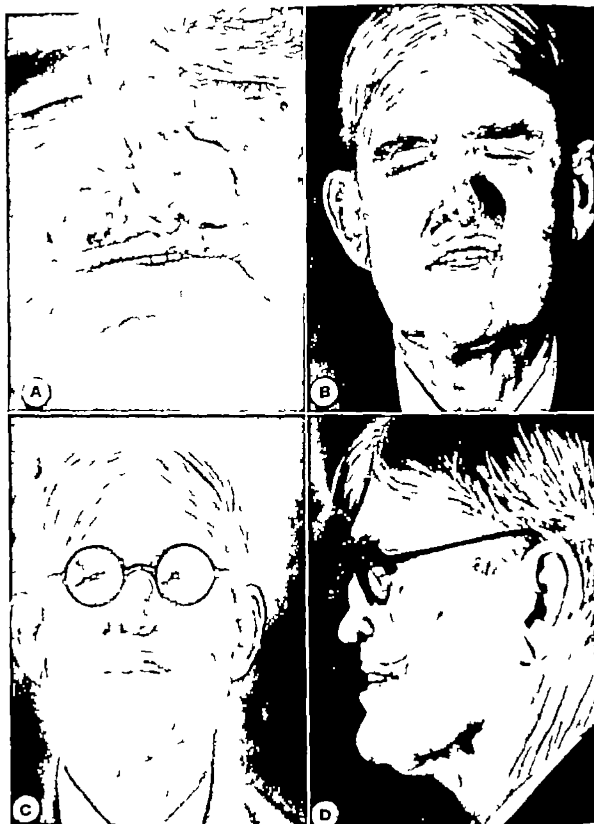


Fig. 626. De[illegible] of nose, cheek, antrum, palate and upper lip by basal cell carcinoma.
A. After electro[illegible]
B. Full denture [illegible] with male attachments on labial surface to hold prosthetic nose.
C. Front view.
D. Side view of art[illegible] nose held in place by female attachment on undersurface fitting male attachment on denture.

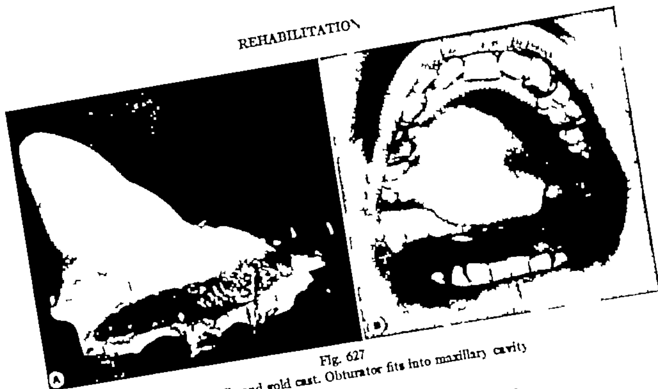


Fig. 627

A. Hollow ball obturator acrylic and gold cast. Obturator fits into maxillary cavity
B Appliance in place in mouth

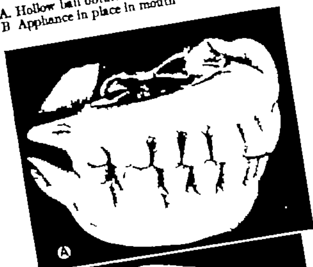




Fig 628

A. Cast gold hollow ball obturator for maxillary cavity lateral view
B View of superior surface

2 Fixed cemented (Figs 623 624)
On natural remaining teeth—some with rubber band attachments and buccal guide plane

3 Removable type
A On partial dentures

Obturators

1 On full dentures or partial dentures
A Maxilla obturators retained by clasps (Fig 625)
B Full upper denture
C With nose attached to labial of upper denture with male and female cast attachments. (Fig 626)
D Hollow ball obturators acrylic (Fig 627) or gold cast (Fig 628)

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4 STABILIZATION OF MANDIBULAR FRAGMENTS AFTER PARTIAL RESECTION

by Milton T Edgerton M D

The control of remaining mandibular fragments following partial removal depends largely on the state of remaining structures The mandible is resected for benign or malignant tumors for osteomyelitis, for non union or traumatic loss and for radiation necrosis.

The problem is made difficult by the mobility of the lower jaw the nearness to the oral cavity and the frequent need to remove surrounding soft tissues skin mucosa or both

When both remaining fragments contain adequate teeth the problem is somewhat simplified Arch bars or interdental wiring may be used to hold the remaining lower jaw in occlusion with the maxilla The use of orthodontic bands with a bar between is a satisfactory variation This bar may have an acrylic block that drops between the resected bone ends

More commonly teeth remain in only one of the lower jaw fragments when one of several methods may be employed to hold the remaining fragments in occlusion

Arch bars may be applied to the teeth of the maxilla and remaining mandible respectively and a stiff metal arm may then extend from either of the fixed arch bars back to the posterior edentulous fragment Attachment there may be by means of a bone screw or a pronged fork thrust through the mucosa or an acrylic saddle (Plate VIII A B) Objections to such methods are (1) cumbersome intraoral appliance with difficult hygiene and frequent discomfort (2) liability to osteitis from bone screw or fork (3) frequent erosion of mucosal covering of bone beneath saddle and (4) necessity for constant liquid feeding between closed jaws for an extended period

An alternative method is fixation of the posterior fragment to the skull by extraoral plaster head cap and steel wire loop through a drill hole in the bone as so beautifully described by Ivy and Curtis. The method is useful—but the fixation is often incomplete and infection may appear about the wire. A useful variation of the head cap principle utilizes the teeth rather than the skull for fixation. A splint is attached to upper or lower jaw From this an extraoral spring metal arm extends out between the lips and back to connect with the posterior fragment near the angle of the mandible This is recently described by Blocker and Weiss.

Both of the above methods utilize teeth in at least one mandibular fragment They are not applicable if the maxilla or both mandibular fragments are nearly or completely edentulous The jaws of such patients must be fixed by bone contact only and the maxilla is rarely of much aid

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Formerly, attempts were made to place intraoral bone screws in each mandibular fragment and connect the two by a bar This was cumbersome and often led to infection. As a result, it has now largely been replaced by the use of an external skeletal apparatus (such as the Haynes-Griffin or Smith-Peterson) with a steel two pin unit in each fragment and an adjustable bar between each unit. However this gives better fixation of fractures than when segments of the mandible have been removed. The apparatus is expensive and must be watched constantly to prevent malposition We have seen cases of osteitis and salivary fistulae (temporary) develop around the site of the pins It is mechanically in the way at the time of bone grafting and makes difficult the obtaining of a sterile field.

An open bite splint of the Gunning variety may be used and held to the bone by circumferential wiring but often the posterior fragment is short and does not extend forward sufficiently to be held firmly by the splint. It thus may be seen that, even in the absence of a mucosal defect the above methods are not wholly satisfactory for the edentulous patient.

In the past few years changes in our concepts of palliative and curative surgery about the head and neck have brought an increasing number of edentulous patients into the hospital for surgery These elderly people stand prolonged operations surprisingly well with the aid of endotracheal anesthesia and whole blood transfusions. Antibiotics have greatly reduced the dangers of fulminant sepsis that lurk within the oral cavity The lower jaw must often be resected for chance of cure We have been on the lookout for a good method of managing mandibular fragments. Surgery often leaves a large mucosal defect. If teeth are present in the remaining mandible, it is possible to place an intraoral acrylic block between bone ends (Fig 280) The acrylic block may be attached to a dental bar and placed in the space left by the removed mandible Or if the posterior fragment contains no tooth the acrylic may be fashioned in the shape of a small saddle that will hold the ramus posteriorly and laterally It is usually necessary in such cases to gain further stability by means of a 'guide plane,' which consists of a short upright post or metal loop on the lower jaw splint. This loop rides against a bar fixed to the buccal surface of two teeth in the upper jaw of the non resected side The mandible is thus prevented from swinging toward the resected side the posterior fragment remains in place The patient avoids the discomfort of having his teeth wired together This acrylic splint may be placed in direct contact with the non-epithelialized area between the bone ends If left in place a number of months, surprising proliferation of epithelium seems to occur beneath the splint These splints require considerable skill in construction and fitting and are advantageously used with good results in some cases (Fig. 629)

Commonly in the elderly cancer patients there is a lack of both A) sufficient mucosa for closure and B) adequate teeth Byars has suggested that an internal stainless steel bar may be placed between the bone ends, Freeman advocates a light vitallium splint. Although these materials are quite inert, they are none the less foreign bodies and if there is any mucosal defect in the postoperative period, we have found a low grade painful osteitis often occurs. This usually leaves only after removal of the metal.

The above observations show that it is essential to make every effort to secure a closed oral cavity at the time of resection permitting the use of internal metal fixation buried within the soft tissues with less danger of infection. When full thickness pedicle flaps are used for mucosal replacement it is possible to place a bone graft within the soft tissues at a later date Furthermore, the immediate application of such flaps has succeeded in almost completely eliminating the serious cicatricial deformities that occurred with the deliberate leaving of oral fistulae or mucosal defects (Chapt. XIX) In the past many of these patients were treated by first resection of the tumor and then consideration of plastic repair of the

soft tissues and restoration of jaw mechanics. Many patients were left with a large oral fistula for many weeks or months and their already poor nutritional state went steadily downhill

As a consequence healing processes were delayed and distant flaps often failed During this interim resultant scarring in the mouth frequently drew the tongue mandibular fragment or pharyngeal tissues into abnormal positions and made subsequent replacement well nigh impossible Through weeks of tube feeding and salivary discharge into a neck dressing the patient s morale often suffered untold damage (Fig. 630)

It now seems to be cardinal in the treatment of such patients to plan the reconstruction as part of the original surgery i.e., the dentists improve the oral hygiene and take impressions of the normal dental arches before resection with minimum delay If preoperative irradiation is to be used much of this work can be carried out simultaneously

Most patients requiring lining flaps and bone fixation have oral carcinomas and a delay of operation for two to three months while distant flaps are prepared seems unjust and unwise. Local pedicle flaps have been employed with excellent success however and cause little delay in removal of the primary tumor Previous x ray therapy often leaves areas of depilated cervical skin which are suited for an intraoral habitat The design of these flaps is discussed elsewhere (Chapt. XIX)

Immediate closure of the oral cavity can easily be combined with internal metallic fixation of the mandible Thus on removal of the primary lesion the mucosa is closed with a pedicle flap the wound is thoroughly irrigated and a stainless steel bar is screwed into the bone ends (Plate VIII E–F) Even if there is some reaction about the pin in the weeks that follow it usually may be left in place until the lining flap heals and until an autogenous bone graft replaces the pin Once healing has occurred even if bone grafting does not seem desirable the pin may usually be removed with little tendency of the jaw to swing out of position We have used 18-8 Mo steel as the material for these pins They may be of the simple Steinman pin variety with threads cut on one end. We have utilized a three-sided sheath to fit the pointed end of the pin The sheath is driven into the anterior mandibular fragment and after shaping the bar at the operating table the threaded end is screwed into the posterior fragment and literally plugged into the sheath by first slightly distracting the jaw fragments. Several bars of different lengths may be available in case there is some doubt as to the limits of bone resection The bar should then lie closely against the soft tissues so that no dead space is created when the skin incision is closed In some cases cast vitallium is used for the sheath In at least one case where saliva continued to contact the bone end containing the sheath the bar and sheath remained firmly in place until its removal weeks later (Fig. 631)

It would seem wise perhaps to include a small circular collar or flange near each end

PLATE IX

A. Operative specimen showing removal of section of right mandible involved with metastatic carcinoma Jugular chain of nodes and submaxillary triangle contents included in continuity (composite operation)

B Operative [illegible] showing removal of symphysis of mandible and adjoining soft tissues for carcinoma of floor of mouth Fixation [illegible] rior fragments of mandible by means of a steel plate Floor of mouth was repaired with pedicle flap [illegible] same operation

C Section of [illegible] applied to remaining jaw fragments following removal of ameloblastoma Steel wire holds graft in pla[illegible] Teeth wired together for five weeks

D Intraoral [illegible] ng removal of squamous cell carcinoma of right upper alveolus, extending into the antrum Maxilla ha[illegible] resected and opening into the sphenoid sinus is visible

E. Same patient [illegible] obturator prosthesis in place

F External app[illegible] same patient three years after removal of alveolar ridge carcinoma. There has been no recurrence Elevat[illegible] ure of mouth could have been prevented by application of lining split graft to cheek at time of operation

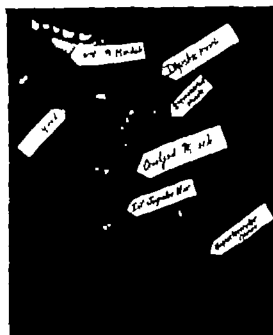












PLATE IX (A-F)

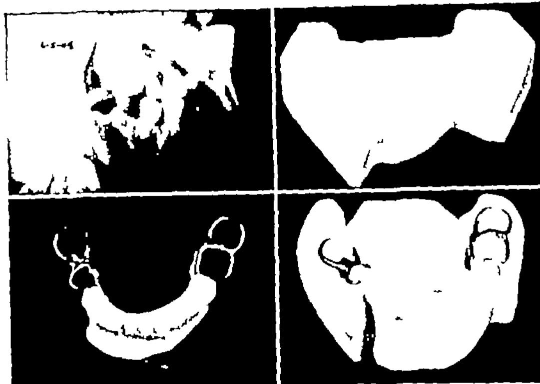


Fig 629

(Upper left) X-ray of mandibular adamantinoma with almost complete destruction of continuity
(Upper right) Plaster model of planned resection.
(Lower left) Acrylic block fitted to drop between bone ends.
(Lower right) Appliance ready for insertion at time of operation. In this patient spontaneous epithelization occurred beneath the acrylic. (Appliance constructed by Riley S Williamson, Jr., D.D.S.) (Figs. 629–637 excepting 636, used by courtesy of Journal of Plastic and Reconstructive Surgery)

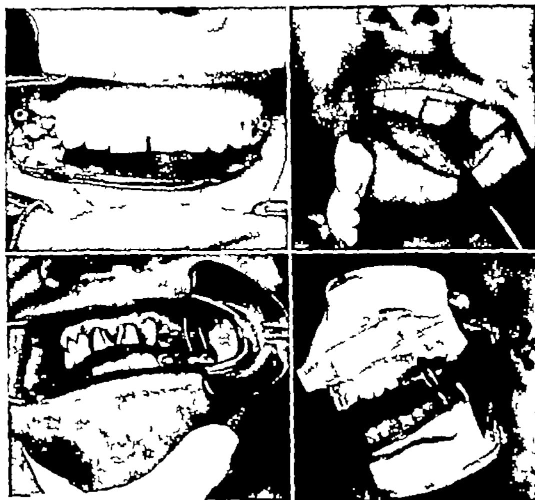


Fig 630

(Upper left) Dental bar used to bridge bone defect at symphysis when adequate teeth are present.
(Upper right) Acrylic saddle to hold left posterior mandibular fragment downward and outward—attached to good teeth in the right side of mandible.
(Lower left and right) Typical "guide plane" to prevent the remaining left jaw from swinging to the right side.

of the bar to prevent its sliding further into the bone as absorption takes place We have had no experience with such a bar flange On occasion we have noted a tendency of the bar to loosen when the patient is placed on a soft diet While this is not a serious objection it probably does contribute to the patient's discomfort To prevent loosening and advancing of the bar a stainless steel plate approximately ¾ cm wide has been substituted This may be fashioned with an angle similar to that of the mandible and anchored to the bone ends with steel wire through small drill holes This is much easier to apply in the case of very thin posterior fragments where the resection level is in the ramus above the angle Care must be taken not to let the edge of such a plate press too firmly against the overlying skin flap postoperatively (Fig 632)

This type of internal fixation offers many interesting advantages First it is simple the materials are cheap and no elaborate craftsmanship is needed to construct the appliances. It can be easily modified at the time of operation if the surgeon finds it necessary to resect more or less bone than he had anticipated *It gives reliable immediate control of the bones* so that pharyngeal collapse does not occur It requires no teeth and does not interfere with postoperative oral hygiene A soft diet may be enjoyed by the patient It does not prevent simultaneous plastic repair of missing skin and mucosa And although we have always attempted a mucosal closure Byars reports mucosal healing even with the bar exposed to the oral cavity

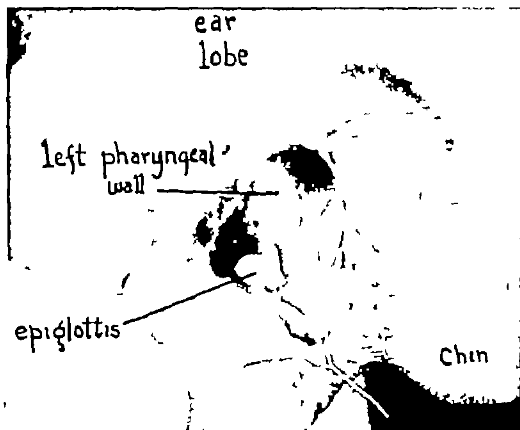


Fig 631 Large Cervical fistula following removal of extensive carcinoma of anterior tonsillar pillar Epiglottis is clearly seen No preoperative plan for lining pharynx was carried out Post-operative management in such a case was extremely difficult

Disadvantages are firstly the presence of a low grade reaction around the metal if saliva should leak through the mucosal closure and secondly a *tendency of the steel bars to* ad



Fig 632

(Upper left) Carcinoma of floor of mouth in edentulous patient age 76.

(Upper right) Block resection from below up spinal accessory nerve was saved and can be seen. A turned under apron flap is being used here for lining

(Lower right) The oral cavity has been closed with the lining flap and the internal stainless steel bar can be seen holding the bone fragments. *Note that the lower portion of the neck wound was closed before entering the oral cavity*

(Center left) Post-operative x-ray showing fragments in place. A stomach tube is shown and was used for *feeding in the immediate post-operative period*

(Lower left) Good jaw function post-operatively with no deviation of tongue or chin

vance slowly into the bone if not properly placed The flat steel plates do not tend to advance One may use such fixation until the chance of local recurrence with malignant tumors is greatly reduced (Fig 633)

Encouraged by our use of this internal fixation in the edentulous patient with malignancy we have applied it to other conditions where alternative methods of mandibular fixation occurs. If the patient has teeth, they may be utilized by the application of a simple guide plane to the opposite side of the jaw, in order to prevent a "sinking in of the bar into the mandible (Figs. 634 and 635)

The method is also of value in children where tooth development is incomplete Some over correction may be carried out in anticipation of growth on the unaffected side.

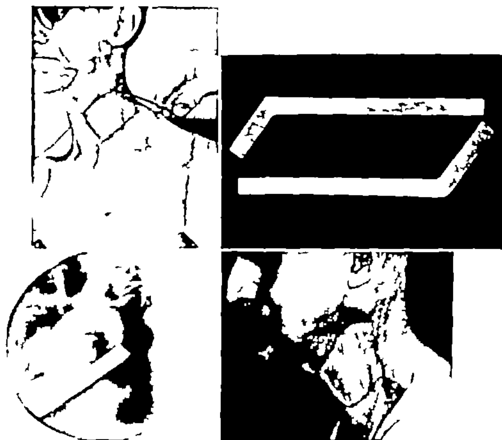


Fig. 633

(Upper left) Lining apron flap turned under prior to block resection of carcinoma of base of tongue and glands of neck. See Chapt 19

(Upper right) A type of stainless steel (18-8 Mo) plate used for fixation

(Lower left) A section of the plate in position.

(Lower right) Patient two weeks after operation with good position of fragments, although edentulous

might be present In cases of subperiosteal resection for benign tumors such as adamantinomas and osteofibromas the bar may be used for fixation with the hope that spontaneous regeneration of bone may occur and obviate the need for later grafting Or if the oral cavity is inadvertently entered and it seems hazardous to undertake immediate bone grafting then the bar may be used while mucosal healing

With very short posterior segments it may be difficult to place the bar in the very thin ramus of the mandible One may then elect to fix only the anterior fragment and practice the policy of deliberate neglect on the ramus In such cases the ramus is usually displaced anteriorly If one does not wait too long this fragment may be pulled back down into position at a later operation when mucosal healing



Fig 634

(Upper left) X ray of patient with extensive carcinoma of floor of mouth involving symphysis of mandible and prognathism

(Upper right) Beginning elevation of previously delayed, lined flap from anterior neck

(Center left) Specimen of mandible removed with ulcer in alveolar ridge. Geniohyoid genioglossus and mylohyoid muscle included

(Center right) Stainless steel plate fastened to resected end of mandible on each side and shaped to lie against the soft tissues. A supplementary Gunning splint was used within the mouth.

(Lower left and lower right) X-rays of post-operative fixation with steel wire running from plate to hyoid bone—thus supporting the larynx in the post-operative period

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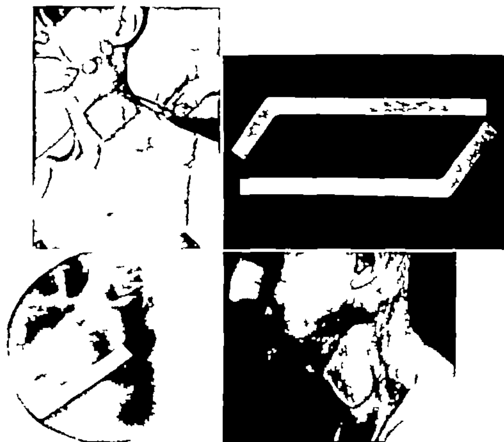


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Fig 634

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(Lower left and lower right) X rays of post-operative fixation with steel wire running from plate to h bone—thus supporting the larynx in the post-operative period

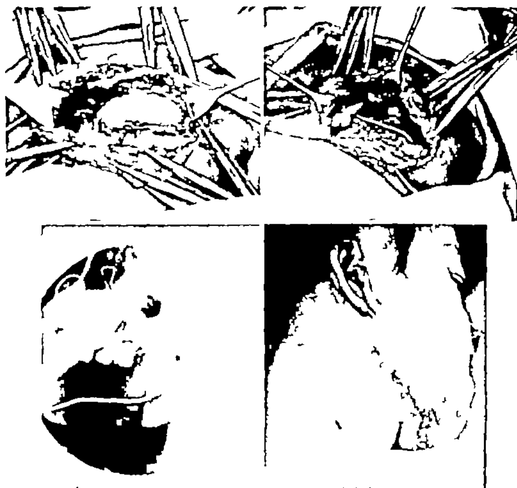


Fig 635

(Upper left) Osteogenic fibroma of right body of mandible.
(Upper right) Steel bar used even with removal of small amount of oral mucosa.
(Lower left) Excellent post-operative position of fragments. Guide plane can be seen to help prevent sinking in of pin
(Lower right) Immediate primary healing of wound.

Fig 636 Maintenance of mandibular fragment with Haynes splint while graft grows in face defect. Patient treated with x-ray therapy thirteen years previously for basal cell carcinoma of skin of right cheek. Three years ago abscessed teeth extracted from right mandible. Severe soft tissue and radio-osteonecrosis followed. Removal of alveolar process and drainage gave only temporary relief. One year ago resection of mandible from canine region to temporomandibular joint resulted in healing. Dense scar tissue pulled left mandible and chin to right.

A and B illustrate marked scarring and deformity

C. Because patient is completely edentulous, Haynes splints were applied by Eugene D Lyon D D.S Pins fixed in left mandible and malar bone. At same operation the scarred skin and soft tissue were excised to the buccal mucosa permitting left mandible to return beyond the midline. This overcorrection allowed for later contraction of postoperative scar tissue. A previously prepared tubular flap with wide extension on distal end was sutured into defect in cheek. Splint and graft remained in place for four weeks during which time patient was allowed to go home. Pedicle disconnected when patient returned.

D Graft needs thinning along lower portion but patient hasn t desired to have this done.

E. Complete upper and lower dentures made by K L. Johnson D D S of Raleigh N C who is nearer patient s home. Note excellent alignment and occlusion of the dentures. The lower denture extends over soft tissues on right side where mandible was removed

F Vertical alignment of dentures maintained while mouth is open. Patient states with much glee that he is able to chew nuts and beefsteak

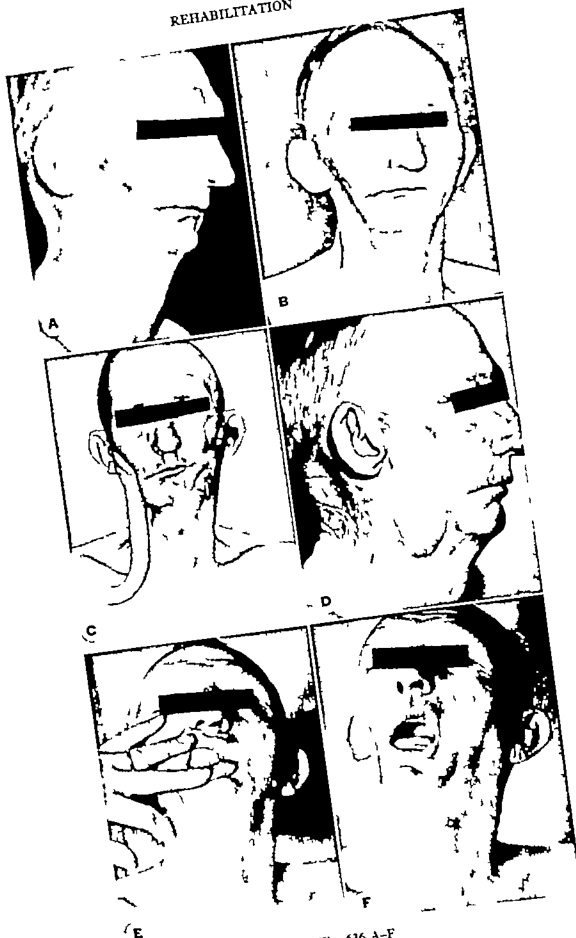


Fig. 636 A–F

is complete. A bone graft can then be used as the method of fixation. Malignant disease may extend posteriorly on the mandible so that the coronoid process and most of the ramus must be resected. In such cases it may be wise to disarticulate the mandible. There is thus no posterior fragment to control. An edentulous anterior fragment may be immobilized in such cases by a Gunning splint or by a Haynes type apparatus between the mandible and the maxilla on the non resected side. We have on one occasion restored the jaw of splinting. He utilizes a folding plastic splint with sufficient bulk to serve as a support for the plastic repair (Fig. 637).

In summary, the fixation of mandibular fragments following resection falls into three groups (Table 46): (1) where both fragments have teeth, (2) where only one fragment has teeth, and (3) where neither fragment has teeth. Each of these may be subdivided into (a) no skin or mucosal defect (i.e., a closed wound) and (b) definite defect in skin or mucosa (i.e., an open wound).

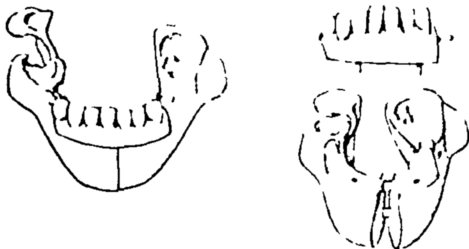


Fig. 637. Reprinted by permission from J. Oral Surg. 1: 59, 1943 and V. Kazanjian. Shows a type of fixation needed when it will require months to bring distant flap tissue for repair.
(Left) Specimen of block resection of floor of mouth carcinoma, half of tongue, right body of mandible and glands of neck.
(Right-upper) Splint used to fix mandibular fragments. Posterior saddle was used to control rear fragment.
(Lower right) Opposite side of such a splint with detailed construction of the guide arm. In this patient, lining of the oral cavity was furnished by a split graft previously applied to the under surface of the skin overlying the tumor.

by use of a rib graft including a curved costal cartilage to fit into the temperomandibular joint. The graft thus helped serve as its own fixation (Fig. 636 and Plate IX-C).

With extensive traumatic injuries, such as shotgun avulsions of symphysis and both mandibular bodies, there is always a concomitant need for skin replacement. These people obviously must have distant flaps and no "internal" fixation is possible at the time of the accident. Kazanjian has already emphasized the importance of early fixation of even the shortest mandibular stumps with some type

By proper planning most of the surgical soft tissue removals that create an open wound can be immediately replaced by some type of graft or flap. In this manner the problem can be converted into essentially a closed wound type. As a closed wound the methods of internal metallic fixation become available. The interesting advantages of internal fixation to patient, surgeon and dentist have been enumerated above. The disadvantages are sufficiently important that one should always use intraoral fixation if both mandibular fragments contain teeth.

TABLE 46

METHODS OF FIXATION AFTER REMOVAL OF SEGMENT OF MANDIBLE

	ADEQUATE TEETH IN BOTH FRAGMENTS		TEETH IN ONE FRAGMENT		EDENTULOUS—BOTH FRAGMENTS	
	Closed	Open	Closed	Open	Closed	Open
Interdental wiring Arch bars. Orthodontic appliances.	Method of choice	Method of choice	No value	No value	No value	No value
Dental splint with saddle, bone fork or bone screw to posterior fragment.	No value	No value	Satisfactory if posterior fragment not too short	Satisfactory but appliance hinders plastic repair	No value	No value
Head cap and steel wire to posterior fragment or extra oral bar attached to intra oral splint	No value	No value	Fair fixation even with short posterior fragment	Apparatus hinders early plastic repair	No value	Good if both bodies and symphysis are missing*
External pin fixation Haynes, Smith-Peterson, etc.	Good if medical contra indications to wiring teeth together	Good if medical contra indications to wiring teeth together	Fair renders field unsterile at time of bone grafting	Apparatus in way at time of plastic repair	Only fair apparatus in way at time of plastic repair	Only fair apparatus in way at time of plastic repair
Open bite Gunning splint and circumferential wiring	No value	No value	No value	No value	Fairly satisfactory if posterior fragment extends 1 cm. anterior to angle.	No value
Immediate massive bone grafting	Excellent if supplemented with interdental wiring	No value	Good if supplemented with interdental wiring	No value	Good if supplemented by external dressings Haynes or Gunning splint	No value
Internal bar steel pin, vitallium splint, etc.	Bone grafting better unless mouth cavity entered	Value here only in children	Excellent may avoid later graft with subperiosteal resection	Excellent if oral cavity is closed surgically	Good may save later grafting and allow staging procedures	Good best if oral cavity is closed surgically
Deliberate neglect and early grafting.	No value	No value	No value	Fair if posterior fragment is very short or very thin	No value	Rarely of value

Wires may join each other behind neck with elastic traction.

* See paper of Marino et al.

With massive traumatic losses of soft tissue and bone obviously no prearranged flap is available Internal fixation is impossible here and one of the older methods must be utilized until flap tissue can be brought to the region

The internal metallic bar or plate has thus proved of value in A) cases where one or both mandibular fragments are edentulous and there is no opening into the mouth B) cases where one or both fragments are edentulous and there is a temporary opening into the mouth at the time of surgery and C) in some cases where a residual mucosal defect remains. In the latter group future bone grafting is usually not contemplated

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